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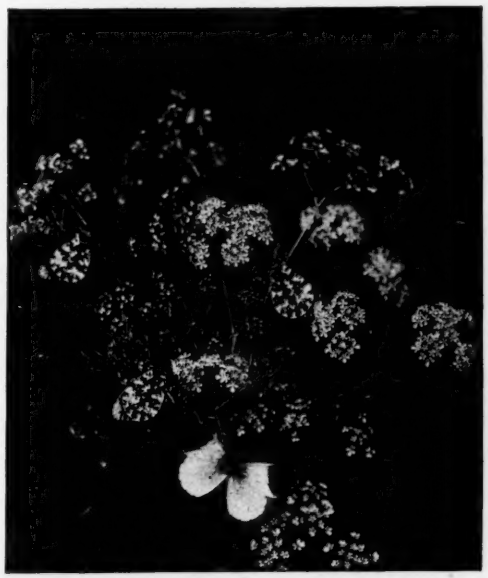
Contents and Notices.—See Page VII.

Flower Mimics and Alluring Resemblance.

By PERCY COLLINS.

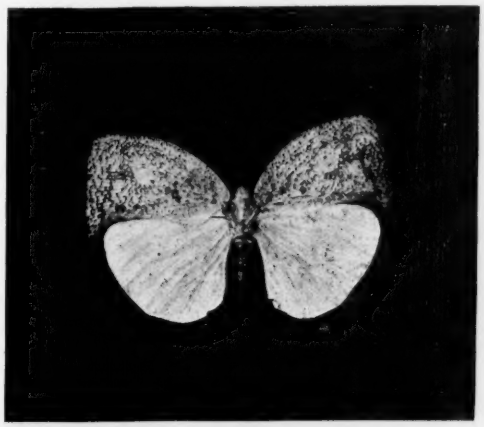
NOT the least curious insects which gain protection from their enemies by means of a likeness to surrounding objects are those which may be described as flower mimics. Of these, some remarkable instances have already been described, nor is it unlikely that others, equally striking, remain to be discovered. Among butterflies, one may often trace a likeness between the resting insect and the buds or blooms amongst which it has settled. This flower resemblance is seen in the case of our common "white" butterflies, which, when settled among such blossoms as those of the pea tribe, bave an



Group of Orange-tip Butterflies and Cow Parsley.

undeniable general likeness to the unopened flowers. Again, a contributor to the *Speaker* recently pointed out the resemblance of the resting "wood white" butterfly (*Leucophasia sinapis*) to the flower buds of the corn wheat—a plant invariably abundant in the woods frequented by this dainty insect. The present writer is able to substantiate this observation, being familiar with one of the few remaining districts wherein the "wood white" is still fairly common.

A more specialised case of floral simulation is seen in the "orange-tip" butterfly (*Euchloë cardamines*), an insect familiar to all lovers of the outdoor world. The upper surface of this butterfly's wings are white marked with



A Species of *Flata* from Perak. (Somewhat enlarged.)

black, with (in the male only) two large orange areas in the fore wings. The colouring of the underside, which is identical in both sexes, seems designed in imitation of a small truss of the tiny white florets of some umbelliferous plant, such as the hedge parsley. Such pale or white flower masses are among the commonest blossoms of the hedgerow in the springtime, when the "orange-tip" butterflies are on the wing. It is, of course, extremely doubtful whether the butterflies have any knowledge of their protective colouring; nor is there any ground for supposing that the insects select the neighbourhood of umbelliferous blooms as resting places. At the same time, it seems quite admissible to suppose that the colour likeness of *E. cardamines* to florescence common in spots frequented by the insect is likely to stand it in good stead as a protective disguise. The underside of the hind wings, between which the fore wings are folded when the insect is at rest, are mottled white and green—the white patches resembling tiny florets, while the green represents the background of vegetation against which they are supposed to be seen. Those who have not observed the "orange tip" butterfly in nature may judge of the closeness of the protective resemblance by a glance at the accompanying photograph.

Several of our common "blue" butterflies have wings mottled and spotted on the under surfaces in a manner which suggests the plantain heads and grass flowers among which these insects are accustomed to rest. And

XUM

as these butterflies are accustomed to go to roost long before twilight has settled in, it is quite likely that their shape and colouring protect them from the attacks of birds.

Perhaps the most curious case of protective flower resemblance is that vouched for by Professor Gregory,

Individuals of a Species of *Flata* grouped upon a Plant Stem. Note flower-like appearance.

and described in his work, "The Great Rift Valley." The insect in question is a species of *Flata*, which is a genus allied to the scale-insects, and to the *Aphidæ*. The species described by Professor Gregory is indigenous to British East Africa, and is dimorphic—a certain number of individuals of each sex being bright pink in colour, while others are bright green. These insects resemble the green fly, or *Aphidæ*, in habits, sitting motionless on plant stems for long periods and feeding upon the sap. The manner in which the individuals of the present species are said to group themselves is very

Brown Mantid, from Usambava, at rest on bark.

remarkable. The pink ones sit upon the lower part of the stem, while the green ones have their place above, towards the extremity. Further, the developing larvæ, which secrete long filaments of a waxy substance, and are quaint, fluffy little objects, sit beneath the pink individuals at the lowest part of the stem. Thus, the exact appearance of a spiked inflorescence is simulated. The fluffy larvæ have a distinct likeness to seed pods. The pink individuals might be mistaken for drooping flowers, while the green ones, higher up the stem, look like so many undeveloped buds. Professor Poulton, however, has remarked that the grouping of green and pink insects in Professor Gregory's observation was probably accidental.

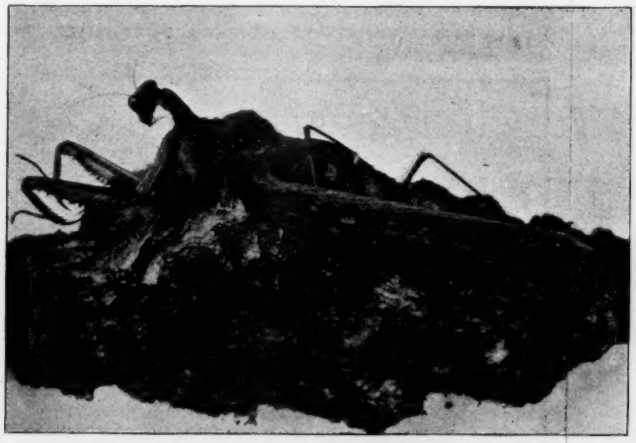
A green Mantid, from Ceylon, lying in wait among foliage.

So far, we have examined only instances of protective resemblance—instances, that is to say, in which the colours, or the colours and form, of an insect are seen to be of value to it as a means of escaping detection. We have now to consider cases in which the appearances of insects, while possibly screening them from the attacks of their enemies, have the additional advantage of enabling them to approach unobserved the creatures upon which they themselves prey. Such instances of resemblance may be termed aggressive.

The curious "praying insects," or *Mantidæ*, afford many striking examples of aggressive resemblance. The whole of this large family is insectivorous in habit, and the majority of

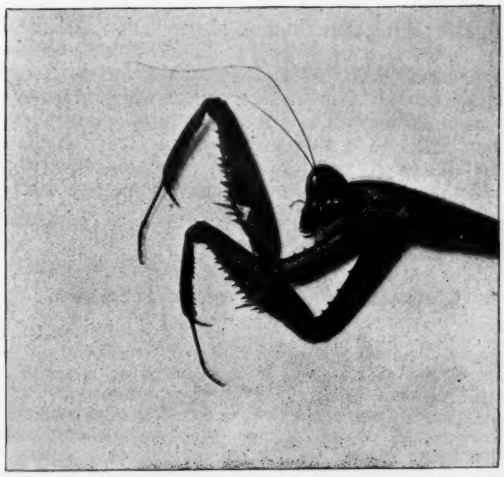
the species are either green or brown in colour. So that when sitting motionless among foliage, or upon the bark of trees, they are not only inconspicuous to such enemies as birds and lizards, but are also hidden from the small insects which form, in the main, their food.

The *Mantidæ* are almost all sluggish in their move-



Another view of same insect.

ments, seeming to be aware that the needs of their life will be best served by tranquillity, rather than by effort. They sit motionless in the sunshine—brown species upon bark, green species amongst foliage—and wait. At most their activity consists in a stealthy stalking among the leaves until they come within striking distance of their victims. The first pair of legs in *Mantidæ* is useless for



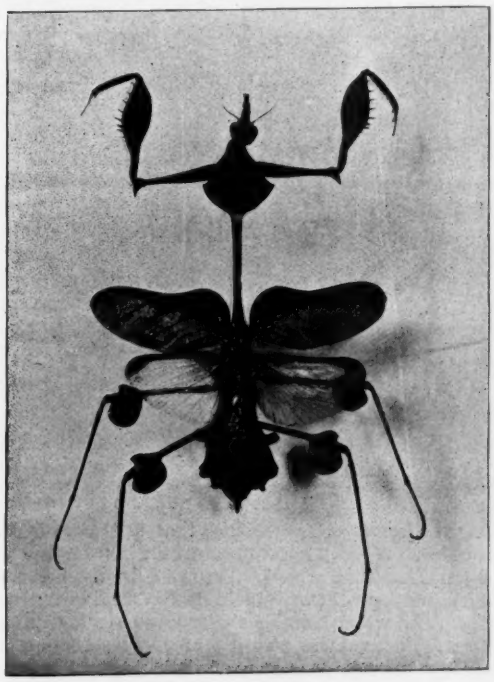
Raptorial Limbs of a Typical Mantid.

walking, but is wonderfully modified to serve as "clappers" for seizing prey. In the use of these limbs the insects are very rapid and dexterous, not only capturing insects which have settled upon a leaf, but even grasping them when actually on the wing. The rows of sharp spines with which the modified femur and tibia are armed make it impossible for the prey to escape when once the Mantis has seized it.

It has been said that most of the *Mantidæ* are either green or brown in colour. A few brightly-coloured species, however, have been described. The colours may be restricted to a certain area or may suffuse the whole surface of the insect. And when these insects assume their characteristic attitudes amongst vegetation, these colours often give them a curiously flower-like aspect. Now, it is well known that highly specialised flowers rely mainly upon the aid of insects to secure cross-fertilisation, and that honey is secreted as a bait to attract the winged visitors. It has, moreover, been demonstrated that the colours and markings of flowers attract honey-gathering insects. Bearing these facts in mind, it is not difficult to realise that a quaintly shaped and brightly coloured Mantis, hanging motionless among green foliage, might, at times, be mistaken by other insects for a flower. That such mistakes actually occur has been vouched for by several observers.

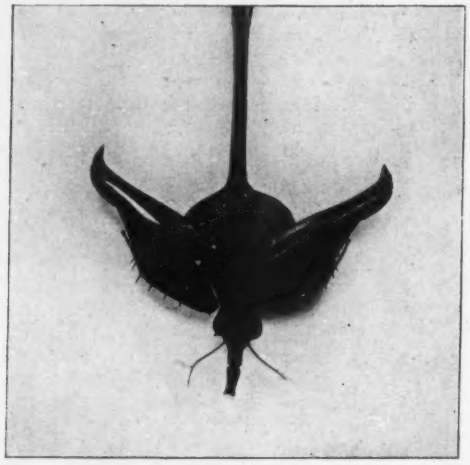
Dr. Wallace mentions an insect (*Hymenopus bicornis*), discovered by Mr. Wood Mason, which attracts insects to their destruction by its flower-like shape and pink or white colour. Parts of the insect's legs are so flattened as to simulate the petals of the supposed flower. In this instance, the whole of the Mantis looks like an orchid, but in the case of *Idolium diabolicum*, from Mozambique, a drawing of which is exhibited in the Natural History Museum at South Kensington, only the under surface of the thorax and fore-limbs have a flower-like colour and form. The body, wings, and hind legs are greenish or brown, in harmony with the foliage by which they are partially hidden when the insect is lying in wait for a meal.

Perhaps the most authentic instance of alluring resemblance is that described on the authority of Dr. J. Anderson. The Mantis is *Gongylus gongyloides* from Southern



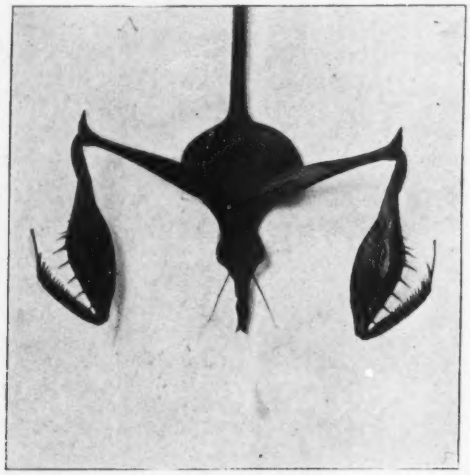
Gongylus Gongyloides, **from Southern India.**

India—a species which has been known to naturalists for upwards of three centuries, but of whose strange habits nothing was discovered until comparatively recent years. Living examples of *Gongylus* have been thus described:* "On looking at the insects from above they did not exhibit any very striking features beyond the leaf-like



Prothorax, Raptorial Limbs and Head of *G. Gongyloides* in Flower-mimicking pose. The insect is hanging head downwards.

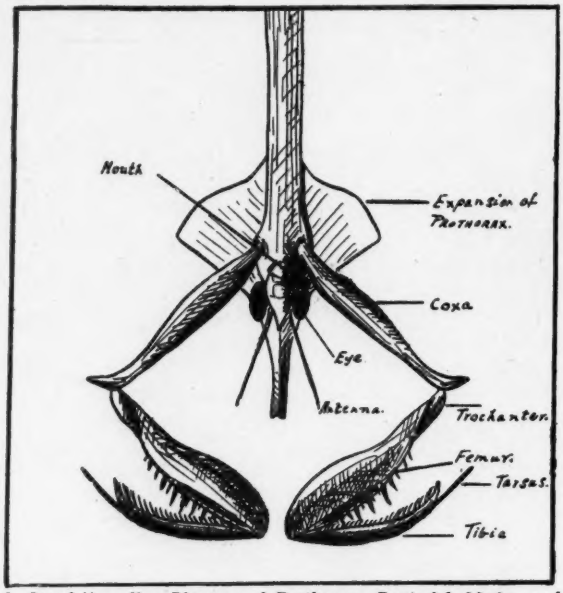
expansions of the prothorax and the foliaceous appendages of the limbs, both of which, like the upper surface of the insect, are coloured green, but on turning to the under surface the aspect is entirely different. The leaf-like expansion of the prothorax, instead of being green, is a clear, pale lavender-violet, with a faint pink bloom



***G. Gongyloides*, as above. Raptorial Limbs expanded to seize prey.**

along the edges of the leaf, so that this portion of the insect has the exact appearance of the corolla of a plant, a floral simulation which is perfected by the presence of a dark, blackish-brown dot in the centre, over the prothorax, and which mimics the opening to the tube of a corolla. A favourite position of the insect is to hang head downwards among a mass of green foliage, and, when it does so, it generally remains almost motionless, but, at intervals, evinces a swaying movement as of a flower touched by a gentle breeze; and while in this attitude, with its fore-limbs banded violet and black, and drawn up in front of the centre of the corolla, the simulation of a papilionaceous flower is complete. The object of the bright colouring of the under surface of the prothoracic expansion is evident, its purpose being to act as a decoy to insects, which, mistaking it for a corolla, fly directly into the expectant, sabre-like, raptorial arms of the simulator."

* Pro. Asiat. Soc. Bengal, 1877, p. 193.



***G. Gongyloides.* Key Diagram of Prothorax, Raptorial Limbs and Head; and Ventral Surface; Insect hanging head downwards.**

A more perfect combination of protective and alluring resemblance than the above could hardly be conceived. The green colouring of the body and legs of the *Gongylus* harmonises with the foliage amongst which it rests, and affords an effective hiding from the sharp eyes of insectivorous birds. The unusual shape and brightly-coloured under side of its prothorax and fore-limbs constitute a lure, by means of which the Mantis attracts to itself the smaller insects upon which it feeds.

Colour-Pattern in Beetles.

IN Vol. X. of the Decennial Publications of the Chicago University, United States, W. L. Tower gives the results of his study of the development of colour and colour-pattern in beetles and other insects. The colours of insects are of two kinds. On the one hand, there is the dermal or typo-dermal coloration, coeval with the group itself, and disposed in spots and strips correlated with the underlying vital organs. On the other hand, there is the coloration produced by scales or modified hairs, which is of much later origin. The latter type of colouring is solely ornamental, its development has had no relation to the vital organs, and is, consequently, much more diverse than the original colouring, which it tends to obscure. A good example of the difference between these two types of colouring may be observed in the contrast between the dull browns and yellows of the ground-beetles of the Catabus genus, and the gay colouring of the Vanessa group of butterflies. Dermal colouring begins in the fore part of the body, where the muscles first harden, and thence spreads to the back. It is obviously concerned with the hardening of the Cuticula, which has a tendency to turn brown, a fact which accounts for the predominance of browns and yellows common in beetles and cockroaches.

The Influence of Fungi

For Good on Other Forms of Life.

GEO. MASSEE, F.L.S.

IN discussing the various phases included under the subject of the influence of fungi as favouring, either directly or indirectly, the welfare of other forms of life, in the order of their relative importance, the first to claim attention is that of fungi playing the part of vegetable scavengers.

When bread, cheese, or other organic substances become muddy or mildewed, the general opinion is that a certain amount of decay has taken place, and therefore mildew appeared as a consequence of such preliminary decay. This idea, however, is not correct, the mould or mildew being the original cause of decay, or change of composition of the body attacked. The spores of fungi are always present in large quantities in the air, and consequently alight on everything not specially protected. The reason why mouldy food is not universal, seeing that it is so much exposed to the air, is due to the fact that fungus spores can only germinate, and produce a vigorous mycelium, under certain well-defined conditions as to temperature, moisture, and the supply of proper food in an available form. The conditions under which fungi can grow most vigorously varies for every kind. Taking temperature, there is a maximum and minimum of heat, above or below which the spores cannot germinate, hence no growth takes place; somewhere between these two extremes there is an optimum point, at which the spores germinate and form the most vigorous mycelium, provided other conditions are also favourable.

Cold storage, whether practised in the primitive manner of placing cooked food in a cool place; the freezing of raw meat; or the storing of ripe fruit in a cool room for preservation, simply means keeping the substance at a temperature below the minimum point at which the spores of the fungus or bacterium known to attack such substance can germinate.

No fungus spore can germinate in the absence of moisture. Again there may be too much or too little water for very robust growth, and in the case of heat, there is an optimum or best proportion under which growth proceeds most actively.

Some few fungi, as the common blue-green mould (*Penicillium glaucum*), and the grey mould (*Botrytis cinerea*), show little or no discrimination in the choice of food, and may appear on almost every kind of dead or decomposed plant remains, and also on many animal products. The majority of fungi are, however, very fastidious in the selection of their food, numerous parasitic species being confined to one particular kind of host-plant; whereas some fungi have carried this selective power to such an extreme as to be actually limited to one particular variety of a species for their food supply.

As scavengers the fungi mostly exercise their influence on members of the vegetable kingdom. Leaving for future consideration the havoc wrought by parasitic fungi on perfectly healthy and vigorous plants, we have still left a very large number known as *saprophytes*, a term which includes all fungi that obtain their food from dead organic matter.

When leaves fall in the autumn, or dead branches fall to the ground, or even when whole trees are blown down, the current opinion is that they decay as a matter of course; but no one who has not studied the matter can realise the influence exercised by fungi in hastening their decay, and the comparatively rapid conversion of such dead substances into water, gases, and soluble

1. **"Horn of Plenty"** (*Craterellus cornucopioides*); **Nat. size. An edible fungus.**

salts, which can again at once be utilised as food by other plants.

It is almost impossible to examine any twig or leaf that has been lying for some time on the ground, without detecting the presence of fungi, either under the form of mycelium in the tissues, when examined under the microscope, or as fruit in the form of a toadstool, etc., on the surface. Now these fungi have fed on the twig or leaf—in other words, have converted part of it into a toadstool. The latter soon perishes in turn and becomes converted into water, salts, etc., as stated above. This condition of things continues until the leaf or twig becomes thoroughly disintegrated and crumbles

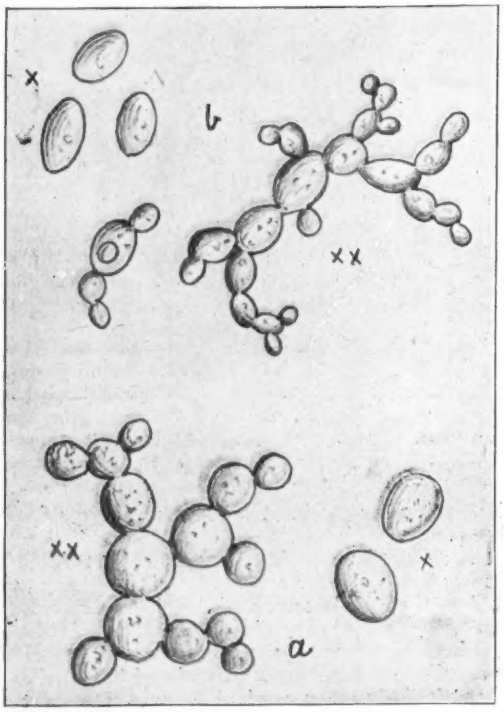
to powder, forming humus in which other plants can grow and find food.

Finally, fungi are responsible for the hollow trunks of trees. The fungus first gains an entrance into the tissue of the trunk through the end of a broken branch, careless pruning, the hole made by a woodpecker, or some other accidental wound. Once in the tissues the mycelium spreads quickly, and in the course of time the heart-wood is rendered brittle, and eventually becomes resolved to powder, which is removed by wind and rain through any openings that may exist, and a hollow trunk is the result.

The almost constant presence of moisture, and varying temperature, are the main factors that admit of fungi effecting the rapid disintegration of dead vegetable matter in woods, etc. As is well known, wood that has been properly seasoned remains sound for centuries, but if allowed to become damp, then fungus scavengers, under the guise of "dry rot" (*Merulius lacrymans*), or other forms, at once commence the work of disintegration.

As an article of food, the nutritive properties of fungi have been much over-rated in the past. It was pointed out that owing to their nitrogenous nature they stood on a par with animal food, whereas in reality modern analysis proves that the composition of fungi varies very much in different kinds; and from a nutritive standpoint the common mushroom (*Agaricus campestris*), the kind most generally eaten in this country, ranks with cabbage rather than with beef.

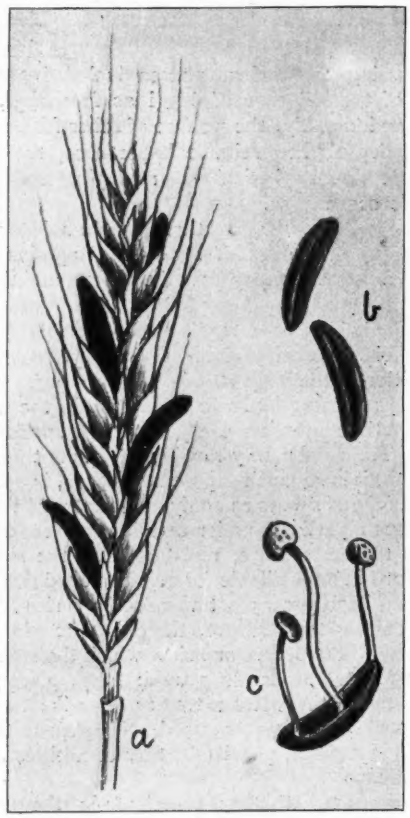
This fact, however, by no means proves that fungi are comparatively useless as food; in fact, the oyster, from the purely nutritive standpoint, ranks little above



2. Yeasts; *a*, beer yeast (*Saccharomyces cerevisiæ*), *x*, single plants; *xx* showing reproduction by budding; *b*, wine yeast (*Saccharomyces ellipsoideus*), *x* single plants; *xx* showing reproduction by budding. Mag. 800 times.

fungi and cabbage, nevertheless it is considered a luxury; and in the same sense, fungi may be regarded rather as luxuries than otherwise, and are of use in rendering more pleasant to the palate substantial articles of food.

There are in Britain at least fifty different kinds of fungi that have been thoroughly tested as to their edible



3. Ergot (*Claviceps purpurea*); *a*, growing on an ear of rye; *b*, ergot removed from its host-plant; *c*, ergot producing its second form of fruit after lying on the ground throughout the winter. Nat. size.

properties, and from amongst these the great variety presented, so far as taste and aroma are concerned, is undoubtedly sufficient to meet the requirements of the most fastidious.

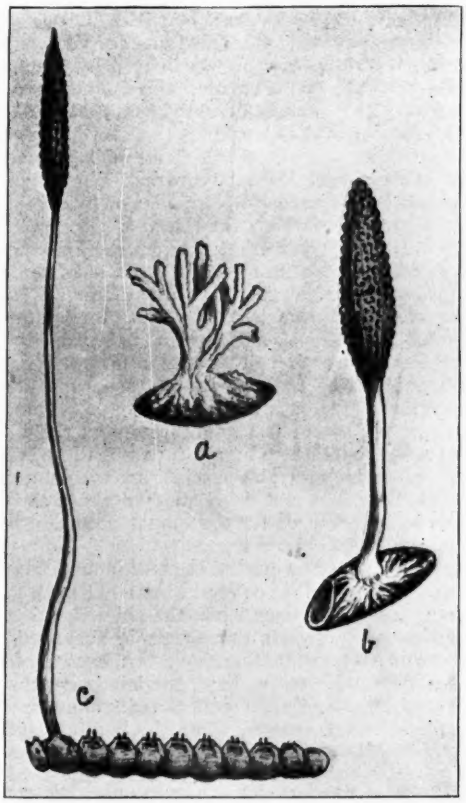
Aroma is most pronounced in the subterranean fungi, which include several edible kinds of truffle. The use of the strong smell to these fungi is to indicate their presence to various animals to whom they serve as an article of food; by this means the spores are dispersed.

From among the number of species eaten in England by mycologists, the one we consider best of all is a fungus which, although by no means uncommon, and during certain seasons very abundant on the ground in woods, is probably quite unknown to the majority of people. It is known as the "horn of plenty" (*Craterellus cornucopioides*), on account of its resemblance to the allegorical Cornucopia, as represented in pictures. The general form is that of a long, narrow funnel with a wavy mouth, two to four inches high, inside blackish-brown, outside grey. This fungus cannot possibly be

mistaken for any other less desirable kind, and when the first prejudice has been overcome, it will doubtless be added to the list of table delicacies.

A peculiar fungus of a somewhat gelatinous consistency and brownish-red colour, having a resemblance in shape a human ear, and popularly known as "Jews' Ears" (*Hirneola auricula-Judæ*), is not uncommon on dead elder trees, and although not usually included under edible species in this country, is perfectly safe to eat, and a closely-allied species (*H. polytricha*) is esteemed as a luxury by the Chinese, by whom it is cultivated on a large scale. When dried, the price of this fungus ranges from £30 to £50 per ton, the retail price being about one shilling per pound. This fungus occurs in abundance in New Zealand, where it is collected for the Chinese market, the annual value of the exports ranging between £15,000 and £40,000.

These amounts are, however, entirely eclipsed by the hundreds of millions of pounds sterling expended



4. Fungi growing on insects; *a*, *b*, *Cordyceps militaris*; *a*, conidial; *b* axiferous form of fruit; both are growing on the chrysalis of some insect; *c*, *Cordyceps acicularis*, growing on a caterpillar. Nat. size.

annually on products depending entirely on the work done by a few closely allied and lowly organised species of fungi known as Yeasts (*Saccharomyces*). The products alluded to are fermented or alcoholic liquors; wines, beers, and home-made ginger-beer alike owe the amount of alcohol they contain to the activity of yeasts.

The yeasts are very partial to sugar as food; in the production of wine, the sugar is present in the juice from the crushed grapes; in brewing beer the starch present in barley is converted into sugar during the preliminary process of malting. In either case yeast is added to the sugary extract, and when the proper temperature is maintained, fermentation takes place. Such fermentation is the index of the vital activity of the yeast or fungus present in the solution.

Under such favourable conditions as regards temperature and food supply the yeast grows very rapidly, increasing in numbers by a rapid vegetative or non-sexual method called budding. During this activity the sugar is used as food, and the by-products, or those portions of the sugar not utilised by the fungus, are given off under the form of carbonic-acid gas and alcohol respectively. The former is the cause of the bubbling or effervescence as it escapes into the air, the latter remains in the liquid.

In olden times, the sweet wort or grape juice was left exposed to the air, and fermentation was effected by yeast cells present in the air coming into contact with the liquid. At the present time the yeast is added to the liquid, and in some breweries pure cultures of different forms of yeast are used, depending on the quality, flavour, or keeping power of the beer desired.

Yeast is quite as indispensable to the baker as to the brewer. To the latter it has been shown that alcohol is the by-product of most value; whereas to the baker, who utilizes the yeast for the purpose of leavening his dough, the carbonic-acid gas is most important. The fungus, being thoroughly mixed with the dough containing sugar and water, commences active growth, and the carbonic-acid gas liberated bubbles up through the tenacious dough and converts it into a light, spongy mass. The alcohol formed is dissipated during the process of baking.

With one important exception fungi are not used medicinally, unless the famous Chinese fungus is admitted. The one included in the British Pharmacopœia is Ergot (*Claviceps purpurea*), the sclerotium of a fungus parasitic on the ears of rye and numerous other grasses, and has a wide distribution.

When flowers of rye, wheat, or pasture grasses are infected by the spores of ergot floating in the air, the part developing into a grain under normal conditions becomes changed into a black, horn-shaped body about half an inch in length, and composed of a solid mass of mycelium, termed a sclerotium; this is the Ergot or part used medicinally. It contains a substance called Ergotine, which, although poisonous, is of great value as a medicine.

When the Ergot is mature its surface is covered with myriads of very minute conidia or summer-spores, which are immersed in a somewhat viscid, sweet substance that is very attractive to flies and other small insects, who, in visiting one grass flower after another, disperse the conidia, and thus effect the distribution of the fungus. When the grass dies in the autumn the Ergots fall to the ground, and remain unchanged until the following spring, when a new form of fruit grows from the sclerotium, the spores of which infect the grass flowers in the spring.

Notwithstanding its medicinal value, Ergot is said to cause serious diseases to human beings when it is ground up along with grain to form flour, and when eaten by horses or cattle it causes abortion.

The Chinese fungus alluded to, and called "summer plant, winter worm" by the Celestials (*Cordyceps sinensis*), is interesting as being one of a small group of fungi that develop on living insects. Some attack moths, wasps, &c., but the majority are met with on

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caterpillars. Although the caterpillar is alive when infection takes place, it slowly dies, and its body becomes filled with a dense mass of mycelium, from which one or more simple or branched, elongated fruiting bodies spring at a later period.

One very beautiful fungus belonging to this section is not at all uncommon in this country, it is called *Cordyceps militaris*, and is generally found growing up amongst moss in damp places in woods. It is club-shaped, one to three inches high, and of an orange-red colour. If the stem is carefully followed down, it will be found to spring from the pupa of some moth or butterfly.

At the present time the knowledge that certain fungi attack and destroy insects has been turned to practical account. Fungi attacking insects injurious to crops, as locusts, cockchafers, &c., are cultivated on a large scale for the purpose of securing quantities of spores. These spores are preserved in small sealed glass tubes until required. When an army of locusts appears the contents of one or more tubes are mixed with water and placed on bread or some other substance eaten by the locusts. The spores thus eaten germinate quickly in the bodies of the insects, and death soon follows. Now as it is the custom among locusts to eat their dead friends, the infection spreads at a great rate. By such means large areas have been cleared of destructive locust swarms in South Africa and elsewhere.

Before the discovery of lucifer matches, a large hoof-shaped fungus (*Polyporus fomentarius*), growing on the trunks of trees, was used throughout Northern Europe for making amadou or tinder. The thick, brown woody flesh of the same fungus, cut into slices and beaten until it assumes the appearance of felt, is used at the present day in Germany for the manufacture of chest protectors, caps, purses, bedroom slippers, and various other articles. A good assortment of such, along with examples of the fungus and the felt, are exhibited in the Cryptogamic room, No. 2 Museum, Kew Gardens, where many other interesting forms of fungi are also on view.

The fact that Lichens differ from other plants in being partly fungal and partly algal, the two collectively constituting the plant, is well known. This condition of things is called *symbiosis*, *mutualism*, or *commensalism;* which means that each benefits respectively by the particular kind of work done by its neighbour, the total result of such mutualism being that Lichens can grow luxuriantly in localities where neither fungi nor algæ, as independent plants, could flourish. It is important to understand clearly the difference between a parasitic and a symbiotic fungus. The former is always injurious, without benefiting in any way the plant it is parasitic upon. The symbiotic fungus benefits, without in any way injuring, the plant it is associated with.

Symbiosis between fungi and other plants has of late years been shown to be much more general than was suspected. In many forest trees, as spruce, larch, silver fir, oak, beech, hazel, &c., the fine rootlets that supply the plants with food are entirely surrounded by a dense weft of fungus mycelium, which acts on the humus in which the plant is growing, in other words, converts the humus into food that can be absorbed by the root of the tree from the fungus surrounding it. The fungus and the rootlet it surrounds is called a *mycorhiza*.

Heaths, orchids, ferns, and all flowering plants not possessing chlorophyll possess mycorhiza, on which the last named are entirely dependent for their food supply.

Fasting Animals.

By R. LYDEKKER.

THE fact that a large number of species of mammals and other animals undergo more or less prolonged and continuous fasts during the period of their winter or summer sleep is familiar to us all. And although undoubtedly remarkable, the phenomenon is not such as to excite any great wonder or surprise in our minds; for during the periods of such slumbers the more active functions of the body are to a great extent suspended, while those that are carried on act slowly and entail comparatively little waste of tissue and energy. Moreover, before the period of the winter torpor or hibernation takes place, many of these animals, such as bears, accumulate large stores of fat on various parts of the body, which suffices to supply all the waste entailed by the respiratory function during the period in question. Fat is also accumulated by certain species, such as the mouse-lemurs of Madagascar, previous to the summer sleep, or æstivation, and is used up in a similar manner; such summer sleeps being, it should be noted, undertaken for the purpose of avoiding the season of great heat and drought, when food is difficult or impossible to procure. Other species, on the contrary, like squirrels, dormice, and hamsters, lay up supplies of food in their winter quarters, on which they feed during waking intervals in the torpor, so that the fast is by no means so prolonged or so continuous as in the case of the first group. There are, however, yet other animals, such as bats, among mammals, frogs and toads among amphibians, and the West African lung-fish among fishes, which apparently neither put on fat nor lay up a store of food during their period of torpor; which in the case of all of them is unusually prolonged. Bats, for instance, generally remain torpid throughout the winter months; while the African lung-fish passes the whole of the dry season comfortably curled up within a nest formed by the caked and dried mud of the river bed. In all these latter cases the fast must accordingly be prolonged and of a severe type.

Nevertheless, whether partial or continuous—whether mitigated by a store of fat or food or not—all such fasts, as already said, take place when the chief functions of the body are more or less completely in abeyance.

In marked contrast to the above is the case of certain members of two widely sundered groups of animals, which undergo a protracted voluntary fast during the breeding season, when the bodily functions are in their highest activity, and there is a strain on the whole system which is unknown at other times. How the creatures manage to exist at all under such circumstances is little short of a marvel; nevertheless, not only do they exist, but for the greater portion of the time they are in the very pink of condition, and it is only when the breeding season is over that they fall away and require a period of rest and good feeding in which to recruit their energies.

The creatures in question are the sea-lions and sea-bears on the one hand, and the salmon on the other.

The fact that the adult males of sea-lions and sea-bears, which constitute the family of eared seals, or *Otariidæ*, fast while on shore with their "harems" during the breeding season has been known for a long time; but it is only recently naturalists have satisfied themselves that the salmon abstains from food, almost,

if not quite, entirely during the period of its sojourn in fresh water.

As regards the fasting of the eared seals, we may take the case of the fur-seals on the Pribiloff Islands, in Bering Sea, as described by Messrs. Jordan and Clark in the Report of the United States Fur-Seal Investigation, published in 1898.

As regards the females, or cows, it is stated that after their first landing they do not leave the islands for ten or twelve days, during which period they must, of course, abstain from food. Whether such periods of fasting are regular or not is, however, at present unknown; but it is certain that neither the cows nor the young bulls (bachelors) fast for any considerable part of the summer, if for no other reason, from the circumstance that they maintain a uniform condition throughout the season, always showing a plentiful stock of blubber, and never looking worse at one time than at another.

Very different is the case with the old bulls, which come ashore about May 1, and do not again go to sea till about July 25, during the whole of which time they remain entirely without food. Like many hibernating mammals in autumn, they are quite laden in spring with fat or blubber, which is gradually absorbed while on shore, leaving the animals thin and greatly reduced at the close of the breeding season. With regard to the condition of the old bulls as they leave the islands after their long fast, some degree of misconception appears to obtain, for although they are undoubtedly much reduced in condition as compared with their state in the spring, yet they are by no means so poor, either in body or spirit, as has been reported. So long as they remain on the breeding-grounds they retain sufficient fighting power and courage to make themselves masters of the situation, and it is only when they move down to the sandy beaches, preparatory to taking to the water, that they become tame and tractable.

Turning now to the case of the salmon, it may be mentioned that, so long ago as the year 1880, Professor Ruesch published a report upon observations made on Rhine salmon, which tended to show that while in fresh water these fish, contrary to popular opinion, seldom or never feed. In fact, among two thousand salmon examined, in only two—and these kelts, or out-of-condition fish—was any trace of food found in their stomachs, which in most cases were wrinkled up and contracted, showing that they had not contained food for a long time. These observations have been fully confirmed by the experiments and examinations recently undertaken on behalf of the Fishery Board for Scotland; while these, again, have been checked, and in some measure corrected, by the independent investigations of Dr. K. Barton. The net result of all these observations is to render it practically certain that from the time they leave the sea until the completion of the spawning operation salmon, as a rule, take no food of any kind. As regards kelts, or spent fish, much the same appears to be true in their case also, but from time to time traces of food have been detected in the stomachs of such fish, showing that they occasionally seize and swallow a tempting morsel. In some slight degree the latter circumstance tends to confirm the popular idea that kelts are more greedy than salmon: the term "hungry looking kelt" being common among fishermen. Nevertheless, the popular idea is in the main wrong, since most kelts (unless, perhaps, in cases where they are prevented from getting back to the sea owing to the lowness of the water) fast as completely as salmon while in fresh water. It may therefore be taken as an established fact that the true feeding-ground of the salmon is the ocean, and that while in fresh water these fish preserve a more or less strict and complete fast.

Much the same is true of the Pacific species of salmon, which belong to a distinct genus (*Oncorhynchus*), and afford a large proportion of our supply of tinned salmon. After leaving tidal waters the throat of these fishes becomes contracted, and their stomachs are almost always found to be empty.

"The tendency to feed," write Messrs. Townsend and Smith, "becomes less the longer they remain, and when one has seen the enormous runs of salmon that sometimes actually crowd the streams, so that it would be impossible to wade without stepping upon them, it becomes apparent that they could not make their rapid journeys to the head-waters of the largest rivers and have time to feed, and that there could not be food enough to supply them if they required it. If such hordes should become hungry while on the spawning-grounds hundreds of miles from the sea, one could imagine the effect on the spawning operations.

"As a matter of fact, the salmon, after leaving tide-water, lives on its own supply of fat and blood. Its flesh becomes less and less red, and the fish becomes thinner as it advances up stream. . . . .

"The degree of emaciation reached and the extent of the injuries received by the salmon by the time it has spawned preclude the possibility of its recovering, even if it reaches salt water alive. Death is a natural result of the conditions."

In thus starving and spawning themselves to death Pacific salmon (of which there are several kinds) differ markedly from our own *Salmo salar*—by far the finer and nobler fish—which may return to its spawning-grounds for several years in succession.

As regards the origin of the fasting habit in salmon, it might at first sight be supposed that all the members of this group were originally sea fish which acquired the habit of entering rivers to spawn, and that, finding the food to be obtained in fresh waters unsuitable to their taste, they refrained from feeding. Apart, however, from the question whether the group may not have been originally a fresh-water one, there is the fact that young salmon—parr and smolt—feed greedily in rivers, where the former are hatched.

The authors here cited suggest that, "in the process of evolution, the salmon may have lost the desire to feed in fresh water through the competition met with in the ascent of the rivers, the great distance to be traversed, and the lack of food in any stream necessary to supply as greatly increased a population of fishes as occurs in the spawning season."

Whether or no this be the true explanation in the case of the members of the salmon group, the voluntary fast undertaken during the breeding season by those fishes, and by the old males of the sea-lions and sea-bears, is one of the most wonderful physiological phenomena to be met with in the whole realm of organised nature.

A CONTINENTAL invention for automobile signals makes whistles of the hollow spokes of the wheels. These are operated by the air action of the wheels in turning, and controlled by a series of small rubber balls. The balls are controlled from the seat, their release opening the valves in the spokes and producing a peculiar whistling noise easily heard above the noise of traffic.

XUM

Photography.

Pure and Applied.

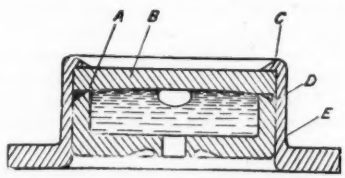
By CHAPMAN JONES, F.I.C., F.C.S., &c.

AT the recent conversazione of the Royal Society there were many exhibits that owed their origin, at least partly, to photography, such as an optical bench for testing lenses, by Messrs. R. and J. Beck, three-colour photographs projected by a lantern in which spectrum colours were used instead of coloured screens, by Sir W. de W. Abney, and photographs and photo-micrographs of various kinds. But the exhibits that seemed to me the most striking were the stereoscopic transparencies, by Mr. Francis Fox, of the Simplon tunnel, now in course of construction through the Alps, and of the Victoria Falls, and also some three-colour lantern slides by Mr. E. Sanger-Shepherd. The first showed how perfectly stereoscopic transparencies, well mounted, convey an impression of the actual object. And when such views are supplemented as these were by samples of the rock taken from the tunnel, one obtains as good an idea of the actual circumstances as is possible without visiting the place itself. Indeed, it is doubtful whether a visit would give much more information to the ordinary observer. The three-colour lantern slides were of various spectra, and produced with such a degree of fidelity that they might well be used for lecture demonstrations when it is desired to show spectra rather than the means of producing them. If, for example, it were wished to show the spectra of the rarer gaseous elements recently isolated, the use of such slides would give quite as good, if not better, results than the production of the actual spectra, without the cost and risk of employing tubes of the gases themselves, and the trouble of fitting up spectroscopic apparatus. Moreover, the slides would probably give a more representative effect, because they would be made under the most suitable conditions, instead of having to get the result during the exigencies of the lecture, and the projection on a screen would be much preferable to the necessity that often arises in such cases of providing instruments for the direct eye observation of the few members of the audience that are fortunate enough to gain access to them.

Reversal.—The reversal of the image is one of the most interesting and mysterious of photographic phenomena. Professor R. W. Wood has catalogued five kinds or types of reversal, and it has been suggested that at least one more should be added to these. I think, however, that these should be called methods rather than kinds of reversal, and believe that there is good reason for considering that there are probably only two kinds of reversal, which I suggest might well be called progressive and retrogressive respectively. That is one in which the effect of the light action is continued, and one in which it is undone. If the effect is regarded as a rotary one, then that part which rotates would continue, in the first case, to rotate in the same direction, while in the second case it would turn in the backward direction, both arriving at, or tending towards, a zero or pseudo-zero point. It does not follow that retrogressive reversal would of necessity leave the sensitive substance in just the same state as it was before it had been affected by light. I shall probably return to this subject on another occasion.

Reversal in Shutter-Speed Tests.—My present intention was not to theorise on reversal, but to refer to a practical result of the Clayden effect; that is, reversal of the developable condition that has been produced by a short exposure to an intense light, by means of a subsequent comparatively long exposure to a feeble light, the latter not producing reversal when it precedes the former. In the use of Wynne's shutter-speed tester, a convex polished metal button moves in front of a graduated diagram, and it is photographed while the sun shines upon the whole arrangement. The length of the streak of light produced by the moving button indicates the period of the exposure. By moving upwards or downwards the pendulum that carries the bright button, several tests may be made on the same plate, if the camera is not moved. Under these circumstances the comparatively feeble light from the diagram produces its effect over the whole surface of the plate during each exposure, including those parts where the bright light from the button impinges on the plate, and this gives the superposed intense and feeble exposures which are liable to give reversal. I made seven tests on each of a few plates, and generally the first streak was reversed, the second and third were hardly discernible, the exposure effect from the bright button being incompletely reversed and the result neither one thing nor the other. I find that it is best to start with the longest exposure and to let the others (generally not more than three) follow. When giving 8, 6, 1½, and ¾ hundredths of a second in the order stated there was no reversal. But 20, 3, 2, 1, and ¾ hundredths of a second gave reversal for 1½ divisions and a feeble effort for the next 4 divisions (each division equivalent to the hundredth of a second) of the beginning of the first streak. The rest of the streak representing the first exposure, and all the others were represented by good black lines on the plate. With a series of 27, 11, 7, and 2 hundredths, 4½ divisions at the beginning of the first were reversed, the next 10 were feeble, and the remainder good strong images. Thus the Clayden effect interferes sometimes in a very practical way under very common-place circumstances, and it is desirable to bear this in mind when giving multiple exposures, as is often done in experimental work. In the particular case referred to, if the sunlight were constant in its brilliancy, the streaks on the plate would all have practically the same exposure, the longer exposures simply giving longer streaks. But the length of the exposure would affect the general illumination of the plate by the surface of the diagram, and it seems that it is desirable to have as little as possible of this to *follow* or to be superposed upon the exposure effect due to the brilliant light reflected from the polished button.

Spirit Levels.—No camera intended for general work is complete without some means of showing when the sensitive surface is perpendicular, and in by far the greater number of cases a circular spirit level is the most convenient and effective apparatus for this purpose.



Messrs. Taylor, Taylor, and Hobson many years ago introduced the level shown in section, and were thereby successful in obviating the leakage which, before

then, was rarely avoided. The glass, B, is united to the cell, A, by the elastic ring, D, the whole being held together and protected by the outer casing E. They have now introduced a level made on exactly the same lines but with the flange for attachment to the camera at the upper part instead of the lower part of the body, so that the level, when fixed, presents a surface almost flush with the woodwork, as shown in the second

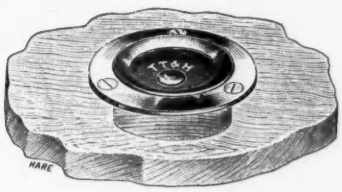


figure. These will be useful in cases where the others were impossible. There is one matter concerning the fixing of levels that is not always attended to, namely, that their sole use is to show when the plate is vertical. They must, therefore, be fixed to that part of the camera that carries the plate. If the back of the camera swings, the level must be attached to the back; it would be useless on the base-board, except only when the swing-back was not in use, and it was certain that the plate was perpendicular to the base-board.

Notes on the Return of Encke's Comet.

THIS comet will be favourably visible this year during the autumnal months. Perihelion will be reached on 1905, January 4, but it will probably be picked up in some of the large telescopes employed in cometary work in August and September next. Its nearest approach to the earth will occur in the third week of November, when its distance will be about 35 millions of miles.

On October 4 the position of the comet will be about midway between the stars β Andromedæ and α Trianguli. Moving westwards it will be found 5° N.E. of β Pegasi on November 1. Its apparent motion will increase, and in November and December be directed to S.W. Early in December the comet will be close to the brilliant star α Aquilæ (Altair). At about this period it will be easily visible in small telescopes, and may possibly be within reach of the naked eye.

This will form the 36th return of the comet (and the 29th *observed* apparition) since it was first discovered by Mechain in 1786. At intervals of 33 years (including 10 periods) the perihelion is reached at nearly the same time of the year as before, and in 1904 the favourable presentations of 1805, 1838, and 1871 will be repeated. In the three years last mentioned the comet was visible to the naked eye. Drawings of its physical aspect in 1871 appeared in *Monthly Notices*, XXXII, pp. 26 and 217, and *Astronomical Register*, X., p. 13.

The comet has been seen at every return since 1819. The following is a list of its perihelion passages, observers, and periods. The average duration of a revolution from 36 returns appears to be 1,206½ days. The nature of the orbit was determined from the observations in 1819.

Returns of Encke's Comet.

	Perihelion.	Observer.	Discovered.	Period Days.
* 1786 I.	Jan. 30	Mechain	1786 Jan. 17	—
1795 ..	Dec. 21	C. Herschel	1795 Nov. 7	1204 (3)
† 1805 ..	Nov. 21	Thulis	1805 Oct. 19	1208 (3)
1819 I.	Jan. 27	Pons	1818 Nov. 26	1204 (4)
1822 II.	May 23	Rumker	1822 June 22	1212
1825 III.	Sept. 16	Valz	1825 July 13	1212
‡ 1829 ..	Jan. 9	Struve	1828 Sept. 16	1211
1832 I.	May 3	Mossotti	1832 June 1	1210
¶ 1835 II.	Aug. 26	Kreil	1835 July 22	1210
1838 ..	Dec. 19	Boguslawski	1838 Aug. 14	1211
1842 I.	April 12	Galle	1842 Feb. 8	1210
1845 IV.	Aug. 9	Walker	1845 July 4	1214
1848 II.	Nov. 26	G. P. Bond	1848 Aug. 27	1205
1852 I.	Mar. 14	Hind	1852 Jan. 9	1204
1855 IV.	July 1	Maclear	1855 July 13	1204
1858 VIII.	Oct. 18	Förster	1858 Aug. 7	1205
1862 I.	Feb. 6	Förster	1861 Sept. 28	1207
1865 II.	May 27	D'Arrest	1865 Jan. 25	1206
1868 III.	Sept. 14	Winnecke	1868 July 14	1206
1871 V.	Dec. 28	Winnecke	1871 Sept. 19	1200
1875 I.	April 13	Holden	1875 Jan. 26	1202
1878 II.	July 26	Tebbutt	1878 Aug. 5	1200
§ 1881 VII.	Nov. 15	Hartwig	1881 Aug. 20	1208
1885 I.	Mar. 7	Tempel	1884 Dec. 13	1208
1888 II.	June 28	Tebbutt	1888 July 8	1209
1891 III.	Oct. 17	Barnard	1891 Aug. 1	1207
1895 I.	Feb. 5	Perrotin, Wolf	1894 Oct. 31	1206
1838 III.	May 26	Grigg	1898 June 7	1207
1901 I.	Sept. 15	Wilson	1901 Aug. 5	1207
‖ 1905 I.	Jan. 4 (?)	—	—	1207

* Discovered near the star βAquarii. Observed on two nights (Jan. 17 and 19) only.

† Independently discovered by Pons, Bouvard, and Huth, on Oct. 20, 1805. It had a tail 3° long.

‡ Distinctly visible to naked eye at end of November.

¶ Boguslawski picked up the comet on July 30.

§ Visible to the naked eye at Bristol in October.

‖ Computed date of perihelion passage.

There were seven unobserved returns to perihelion between 1786 and 1819, computed by Encke to have occurred as under :—

1789	May 19.
1792	September 4.
1799	April 11.
1802	August 2.
1809	March 12.
1812	June 26.
1815	October 13.

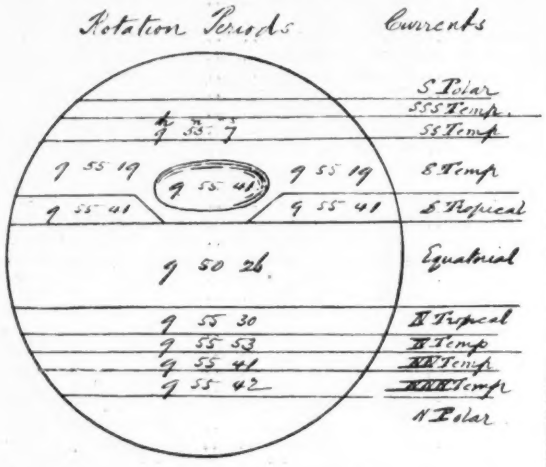
Encke found the period of the comet in 1789 to have been 1,212 days 19 hours. Seagrave, in *Popular Astronomy*, 1904, February, gives the present period as 1,206 days 20¼ hours, and says the time has decreased very nearly six days. This decrease would amount to about four hours per revolution. He gives an ephemeris for the coming return, but it has not been corrected for perturbations, and will, therefore, not accurately represent the path of the comet. No doubt Mr. Crommelin will supply a reliable ephemeris in later months. The comet, having a very interesting history as the first one known belonging to the Jovian family, as having suggested the idea of a resisting medium, and as having a smaller orbit than that of any other comet, should be followed by everyone possessing a telescope next autumn as it travels from Andromeda slowly through Pegasus and Aquila southwards to Capricornus.

W. F. DENNING.

XUM

Jupiter.

IT is fortunate that in recent years Jupiter has been studied attentively at every opposition. The markings have been watched from the time when the planet rose about two hours before the sun to the time when he set about two hours after it. In fact, the observations have generally ranged over nine months of the year, and have been only



discontinued when Jupiter approached near the sun. Since 1898 we have gained a useful insight into the rates of motion of the various currents, and of the positions and changes of the belts. This continuous study of the Jovian surface must be maintained. It will ultimately prove of great value in elucidating the changes taking place in the velocity and aspect of the various spots, and it may be the means of revealing periodicity either as regards the motion or appearance of certain features.

In and since the year 1898, the writer, at Bristol, has found the rotation periods of the chief currents as under:—

Year.	N. Temp.	N. Trop.	Equa.	Red Spot.	S. Temp.
	h. m. s.	h. m. s.	h. m. s.	h. m. s.	h. m. s.
1898	9 55 50.1	9 55 26.3	9 50 23.6	9 55 41.8	9 55 20.5
1899	,, ,, 53.5	,, ,, 28.8	,, ,, 24.6	,, ,, 41.9	,, ,, 18.6
1900	..	,, ,, 30.0	,, ,, 24.1	,, ,, 41.7	..
1901	,, ,, 50.2	,, ,, 31.6	,, ,, 29.1	,, ,, 40 9	,, ,, 19.7
1902	,, ,, 56.5	,, ,, 29.8	,, ,, 26.7	,, ,, 39.0	,, ,, 18.7
1903	,, ,, 54 3	,, ,, 31.9	,, ,, 27.9	,, ,, 41.6	,, ,, 18.5

Somewhat similar observations and reductions have been made in recent years by Professor G. W. Hough, Captain Molesworth, Rev. T. E. R. Phillips, and Mr. A. S. Williams. When the work has further progressed through future years it will be important to compare all the accumulated materials to see whether some useful deductions cannot be made from them.

The mean periods of rotation from all observations in the table are:—N. temp. spots = 9 h. 55 m. 53 s., N. trop. spots = 9 h. 55 m. 30 s., Equatorial spots = 9 h. 50 m. 26 s., Red spot = 9 h. 55 m. 41 s., S. temp. spots = 9 h. 55 m. 19 s. Thus the N. temp. spots move slower while the equatorial spots move quicker than any others observed in recent years. Of course, the most interesting object on the planet is the great red spot which for a long period has been so faint as to have scarcely merited that designation. But it was a little p'ainer during 1903 than in the few preceding years, and possibly it will be still darker during the present summer. The following are a few times when this marking will be on or very near the planet's central meridian. If the spot should not be visible the conspicuous hollow in the S. equatorial belt will show its position, and the time of transit of the latter object should be taken.

Date 1904.	Transit of Red Spot. h. m.
June 2	15 25
7	14 34
9	16 12
14	15 21
19	14 29
21	16 8
24	13 38
26	15 16

To the various other markings particular reference need not be made. In recent years they have, however, been very numerous, and many of them conspicuous. Any spots which may appear near the poles of the planet should be watched with great attention.

W. F. DENNING.

The Leg and Foot of a Spider.

AT the conversazione of the Royal Society this photo-micrograph, which forms our full-page illustration, was shown, with many others. The aim of the exhibitors, Messrs. Arthur E. Smith and Richard Kerr, was to point out the value of direct photography on to a 12 by 10 inch plate and to show its advantages over enlargements made from smaller negatives. The details obtained at once by combining an unusually large camera with a monocular microscope are greater than those secured by ordinary amplifying methods. This illustration represents an enlargement of 260 diameters and has been obtained by a one-inch objective and a focal length of 37 inches approximately. The negative has received no touching up whatever.

THE expeditions at present afloat and organising for discoveries in the North Pole regions, as summarised by the *American Inventor*, are (1) that of the Russian Baron E. Toll, who left the island of Kotelnoi, in the New Siberian group, over a year ago, and has not since been heard from; (2) the new Ziegler expedition, commanded by Captain John Haven, which left New York last spring, reached Tromsoe near the end of July, and upon attempting to make Franz-Josef Land met with obstacles which have deferred further attempt till next spring; (3) an expedition projected by Captain Drake, who will sail for Vladivostok and Point Barrow in Alaska, whence he will later make a "dash for the Pole"; and (4) Lieutenant Peary's new venture, which was announced in the early part of September. The Norwegian Amundsen is supposed to be among the islands of British North America in search of the magnetic pole.

The Leg and Foot of a Spider.

XUM

The Solar Atmosphere at Different Levels.

By E. WALTER MAUNDER, F.R.A.S.

IN "KNOWLEDGE" for October, 1903, we published a fine photograph of the sun in K-line, taken on April 27, 1903, with the Rumford spectroheliograph attached to the great 40-inch refractor of the Yerkes Observatory, by Professor George E. Hale and Mr. Ferdinand Ellerman. This spectroheliograph, a photograph of which was given in the same number, has a train of two prisms of 60°, set at minimum deviation for the K-line. The collimator and camera lenses are of the portrait lens type by Voigtlander with apertures of 6¼ inches. They are of equal aperture and focal length (33 inches), and may be focussed singly or together by means of a rod connecting the pinions which move each lens in its tube. The tubes of collimator and camera are parallel to each other, the light from the collimator being reflected from a plane mirror on to the first surface of the prism train. If required, a much higher dispersion can be obtained by substituting a grating, ruled with twenty thousand lines to the inch, for the above mirror, the first order spectrum being employed. The second slit of the instrument is, of course, placed close to the focus of the camera lens, and the great 40-inch telescope is made to move slowly in declination by means of a slow motion electric motor, the sun's image consequently moving at a uniform rate across the first slit, whilst the photographic plate is at the same time driven at the same rate across the second slit by means of a shaft led down the tube of the telescope from the motor. The motion of the focal image of the sun, produced by the motor, is about one minute of arc in four seconds, when one set of gears is employed, and in twenty-four seconds when another. The two slits are each 8 inches in length, and are given the proper curvature necessary to eliminate the distortion of the solar image. But, as the focal length of the great refractor is 64 feet, and the image of the sun in the principal focus is consequently a little over 7 inches in diameter, the aperture of the spectroheliograph is not quite sufficient for a full image of the sun, and occasioned the falling off in brightness at the two opposite limbs of the sun, noticed in the plate published in "KNOWLEDGE," opposite p. 229 in the last volume.

At that time Professor Hale wrote:—"By setting the second slit on various parts of the K-band it is possible to photograph sections of the calcium flocculi at different elevations above the photosphere. This is due to the fact that the width of the K-band is determined by the density of the vapour; hence, if the slit is set near the outer edge of the broad band, it can receive light only from the calcium vapour, which is dense enough to produce a band of this width. When the slit is set near the centre of the band it receives light from all the vapour lying below the corresponding level. But as the vapour expands as it rises, a given photograph always shows the structure corresponding to the lowest density (highest level) of the calcium vapour competent to produce a line of the necessary width. I shall publish very soon a series of photographs showing how spots are successively covered by overhanging calcium clouds in photographs taken at different levels."

This promise has been fulfilled in the recently published Memoir on the Rumford Spectroheliograph which forms Vol. III., Part I., of the Publications of the Yerkes Observatory, from which we are enabled to reproduce four photographs out of the great number by which the Memoir is illustrated. The four chosen, Figs. 1 to 4, represent the great spot group of 1903, October 9, as photographed with the slit placed in three different positions on the H-line of calcium and upon the centre of the F-line of hydrogen.

In the last number of "KNOWLEDGE," we reproduced a portion of one of M. Janssen's superb photographs of the solar surface, showing in a very distinct manner the curious structure which it presents. The minute granulation which the disk thus either shows to the eye under the most perfect conditions of seeing, or reveals to the photographic plate when the precautions taken

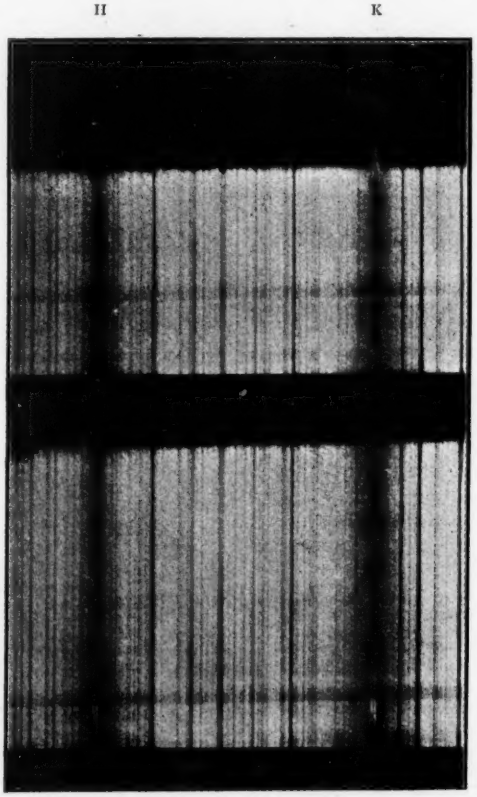


Fig. 5. H and K lines on the Disk, in the Chromosphere, and in a Prominence (a).

by M. Janssen are employed, has its parallel also in the structure shown by the calcium "flocculi" (to adopt the word suggested by Professor Hale, and generally accepted), revealed by the spectroheliograph. From the greater difficulties of the work the granulation shown by the flocculi is not in general so minute as that shown on Janssen's photographs, and in many cases their granules appear to have run together to form the great fleecy clouds so conspicuous in the photograph reproduced in October of last year. Professor Hale, on the working hypothesis which he at present employs, considered the minute floccular granules as columns of calcium vapour, rising above the columns of condensed vapours of which photospheric granules are the summits. The question arose whether these larger calcium clouds were made up of similar columns of

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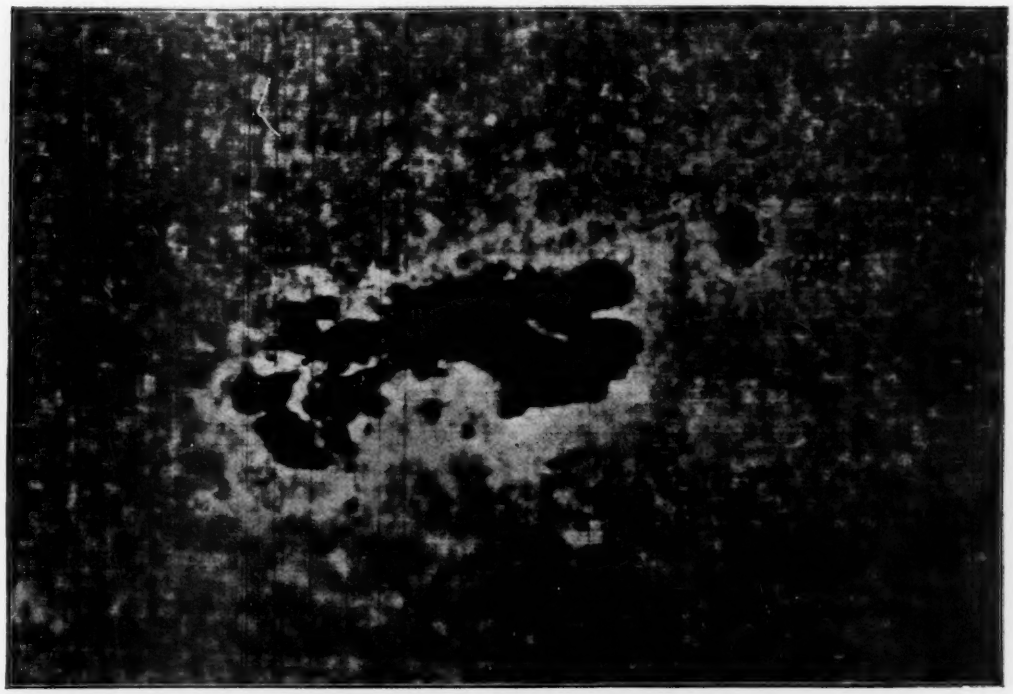
E.  W.

Fig. 1.—1903—October, 9 d., 3 h., 42 m. Calcium Flocculi, Low H_1 Level.

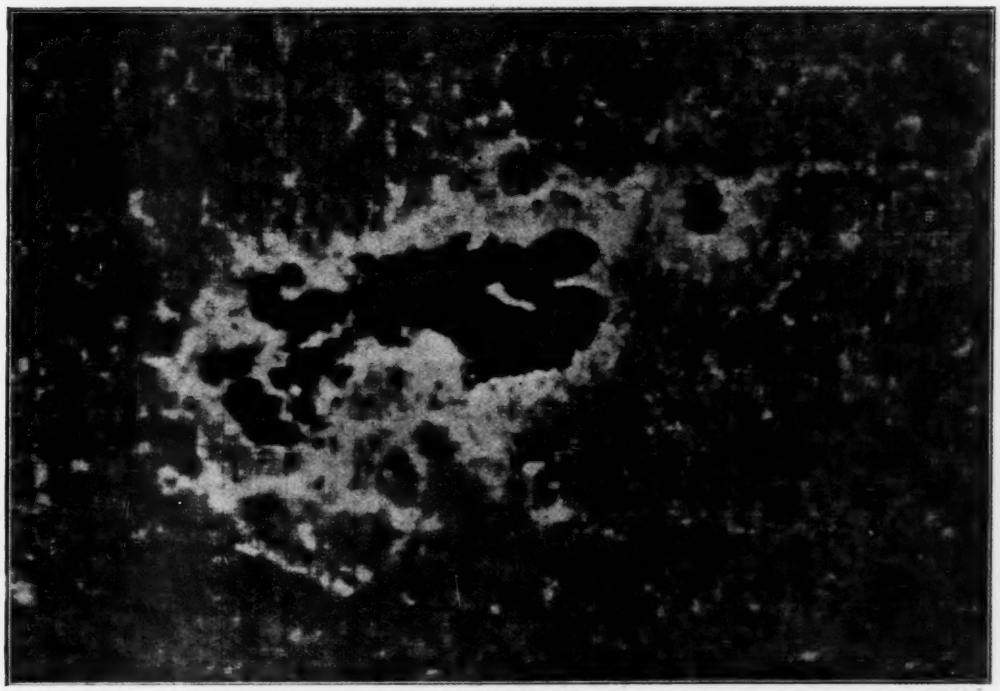
E.  W.

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Fig. 2.—1903—October, 9 d., 3 h., 43 m. Calcium Flocculi, Middle H_1 Level.

THE GREAT SUNSPOT OF 1903—OCTOBER.

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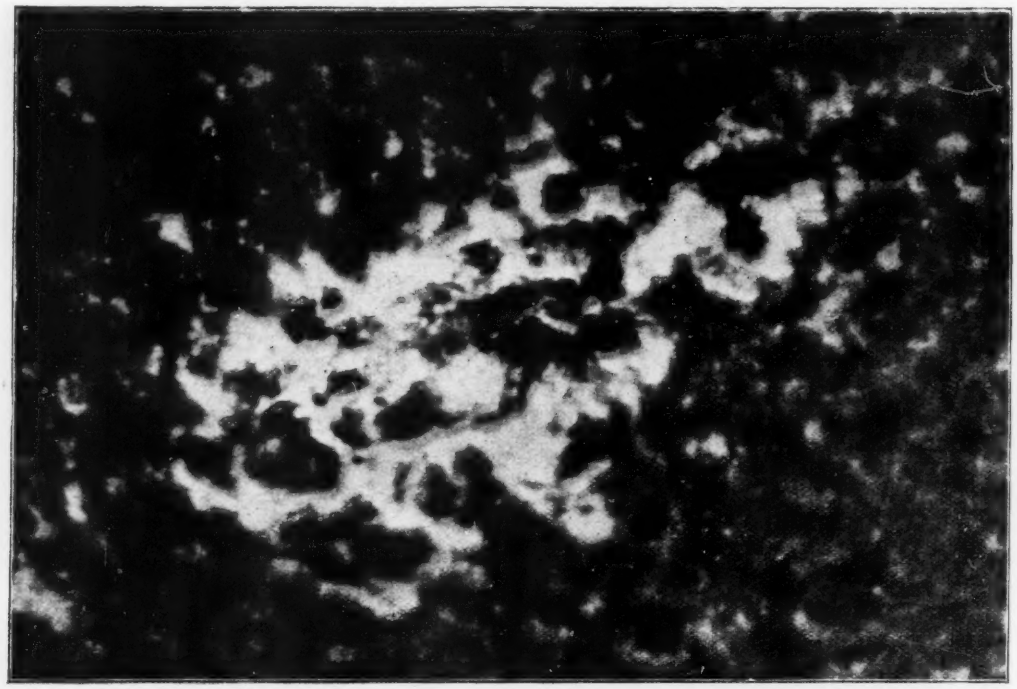

E. W.

Fig. 3.—1903-October, 9d., 3h., 30m. Calcium Flocculi, H_2 Level.

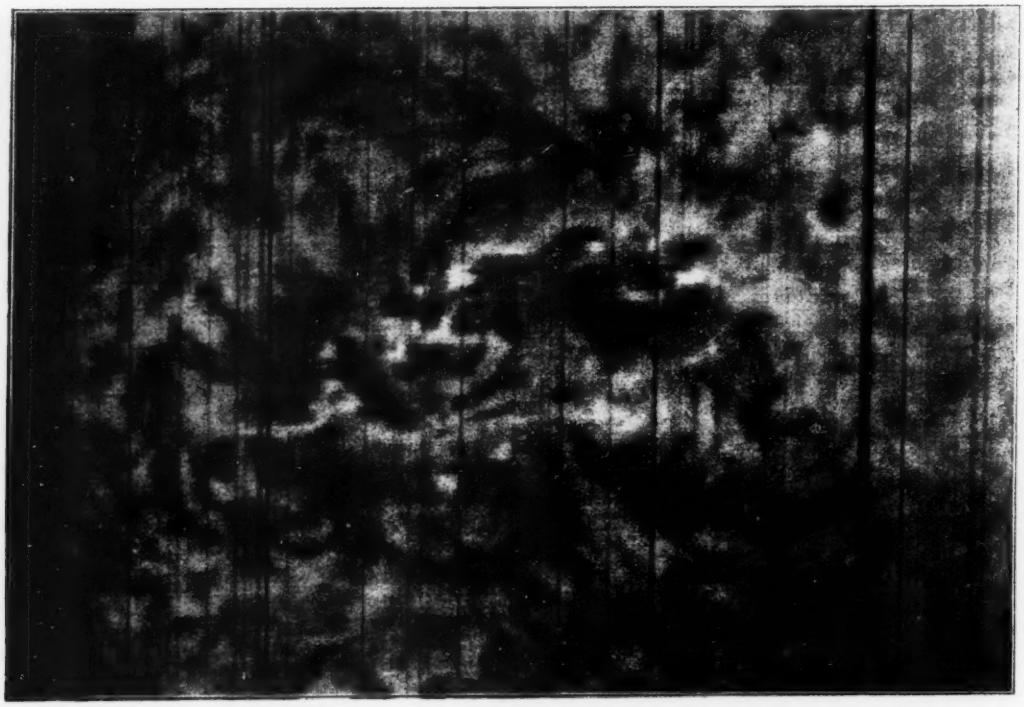

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Fig. 4.—1903—October, 9d., 1h., 4m. Hydrogen Flocculi.

THE GREAT SUNSPOT OF 1903—OCTOBER.

calcium vapour, and the method by which Professor Hale endeavoured to answer this question is one of great ingenuity and interest.

Referring to Fig. 5, which is extracted from one of the plates of the same Memoir, the H and K lines are there seen as photographed on the disk in the chromosphere and in a prominence. Upon the disk the H and K lines are seen as usual as broad and diffuse bands. These, in the chromosphere, are replaced by bright lines which are fairly defined. At the top of the figure, in a prominence, these bright lines thin out into very much narrower lines, changes which correspond to the different phases of the bright lines of calcium, obtained when a considerable quantity of calcium vapour is introduced into an electric arc. Under these circumstances, broad bands, bright in the centre and fading towards both edges, appear in the places of H and K. The width of these bands decreases towards the outer part of the arc where the calcium vapour is least dense and relatively cool; whilst in the centre of the broadest part of the bands a thin dark line is seen, due to the absorption of this cooler rarer vapour in the outer part of the arc. So it is no doubt with the calcium vapour surrounding the sun. The darkness of the calcium bands, H and K, would be due to the calcium vapour being cooler than the photosphere below it, whilst their breadth would indicate that in this lowest stratum it is of considerable density. Higher up, as we see in the behaviour of the bright H and K lines at the limb, the density of the vapour is diminished, and the lines are fairly well defined. For distinctness of reference, Professor Hale denotes the broad diffused bands as H_1 and K_1, whilst the narrower lines he calls H_2 and K_2; the very thin lines seen in the upper chromosphere and prominences being H_3 and K_3. It will be noticed, on examination of the calcium lines on the disk, that at times we have a bright H_2 or K_2 line, superposed on the broad dark band H_1 or K_1 whilst this bright line is bisected again by the extremely narrow dark line H_3 or K_3.

The explanation of the principle upon which Professor Hale works will now be evident. If the second slit be placed at the edge, say of the K_1 line, it is manifest that only that calcium vapour which is sufficiently dense to produce a line broad enough to reach the slit can act on the photographic plate. The upper rarer strata of calcium vapour, giving lines of smaller breadth, will lie outside the slit, and their light will therefore be screened from the plate. Under these circumstances the photograph obtained is virtually that of the lowest stratum of calcium vapour. If the slit be set nearer to the centre of the line, but not at the centre, it is clear that, as before, the highest strata giving lines too narrow to enter the slit will be shut out from recording their presence. But it may be urged that it might nevertheless include regions lying below it where the calcium vapour is dense enough to produce a broader line. However, as Professor Hale puts it, "Since the calcium vapour is rising from a region of high pressure to one of much lower pressure, it must expand as it rises, and therefore a section at any level should, in general, be of a larger area than a section of the same flocculus at any lower level. As a consequence of the increasing extent of the vapour with the altitude, and the increase of brightness observed when passing from K_1 to K_2 a photograph corresponding to a given level is not necessarily affected in any considerable degree by the existence of the denser vapour below, except in cases where the high-level vapour does not lie immediately above the low-level vapour." Broadly speaking, therefore, and not using the term "level" in too precise a sense of altitude, it would seem that this ingenious method does give us a view of the distribution of the more or less heated columns of calcium vapour at various levels above the surface of the sun.

The first three photographs in the accompanying plates show the well-known great spot of last October 9 as photographed with the slit at different positions on the great H-line. Fig. 6 in the text gives the same spot as photographed in the ordinary manner. In all three of the calcium photographs some of the salient features of the great spot group can be detected. The little nearly circular herald spot, the heavy compact form of the preceding half of the great group, the sinuous bridge which traverses it from west to east, and the more complex structure of the following half of the group, can be made out at each of the three "levels." But whilst the bright flocculent matter is quite restricted in area and granular in character in the first photograph, it increases in brightness and becomes much more coherent in character, extending over a much wider area as we proceed from the first to the second photograph, and again from the second to the third. Indeed, the bright clouds of the third photograph all but hide the great sunspot from view. The three pictures taken together

Fig. 6.—The Great Sunspot of 1903, October 9. Photographed with the Greenwich Photoheliograph.

seem to afford, therefore, clear indications of the expanding of the vapours as they rise.

The fourth photograph (Fig. 4), representing the same area of the sun, differs from them totally in appearance. This was taken on the F-line of hydrogen. The little pioneer spot can still be identified, and some portions of the umbra of the great spot that followed it. But the spot as a whole is hardly recognisable, although its outline is not concealed by spreading masses of bright clouds as in the third calcium photograph. Indeed, not a few of the bright structures seen in the calcium photographs are here represented by dark forms. The character, too, of these forms differs; the hydrogen structures suggesting storm and stress, whilst those of calcium rather are appropriate to the processes of quiet precipitation. It should, however, be borne in mind that, whereas on the explanation here given, in the calcium photographs we are dealing with quite restricted strata of the sun's atmosphere, the hydrogen photograph gives us the summation of the effects of many strata. For as the hydrogen line is much narrower than the two giant lines of calcium, it is not possible to isolate small portions of it in the same way.

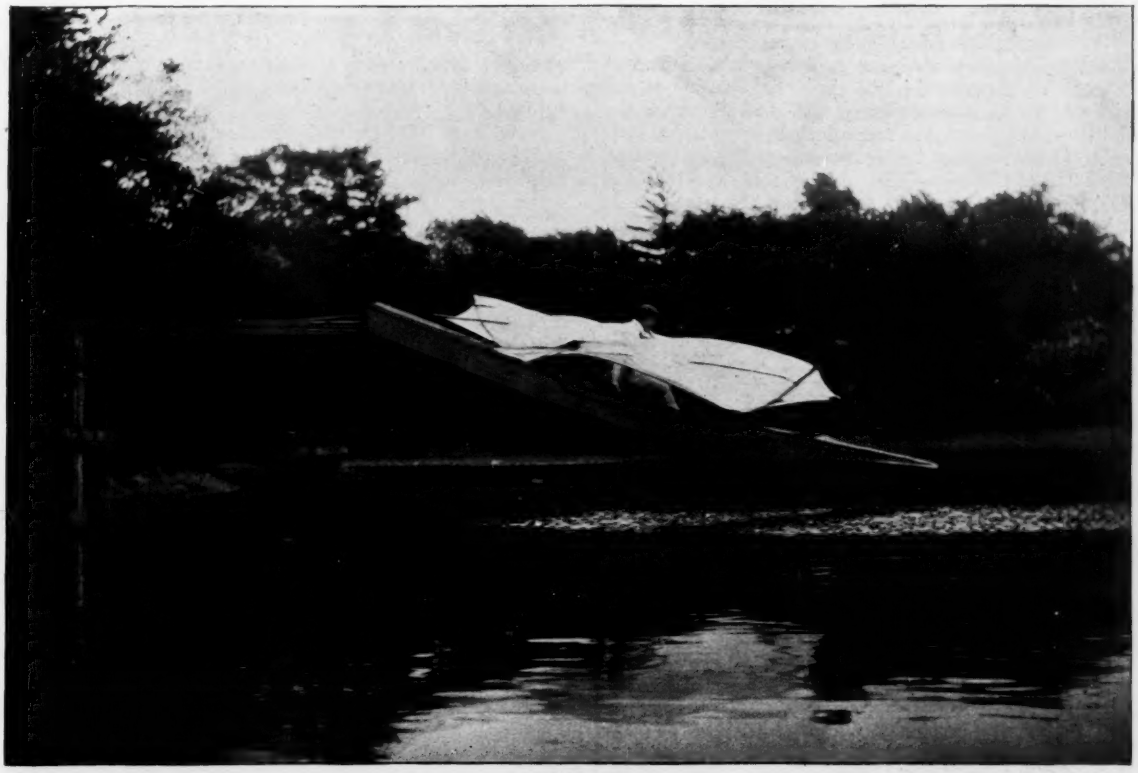
XUM

Aeroplane Experiments.

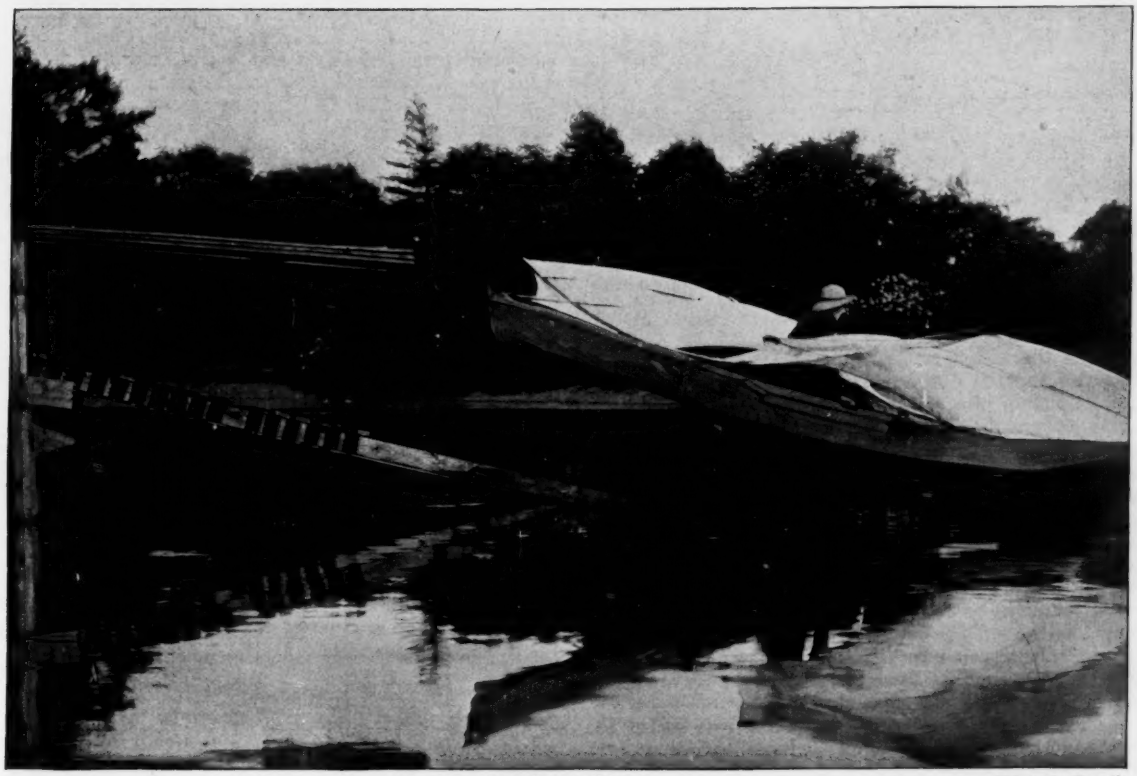
By MAJOR B. BADEN-POWELL.

IN the last number of "KNOWLEDGE & SCIENTIFIC NEWS" was described the apparatus which I have erected at the Crystal Palace for giving initial impulse to a man-carrying aeroplane in order to test the balance and steering arrangements. Since this account appeared many more experiments have been conducted, although we have learnt what a vast amount of small details need alteration and adjustment before good results can be obtained. Repeated trials showed that the boat sliding down between the inclined rails did not nearly attain the speed which it should have accomplished according to theory, and it was only after many days that one cause of this was discovered. Although the gauge of the track had been carefully tested on completion, and though the inside of the rails appeared to be perfectly straight, a subsequent measurement of the gauge, after the structure had been subjected to many days' alternate sunshine and rain, proved that the wood had swollen and warped so that there was a slight contraction about half way down. This was just sufficient to cause the boat, in its descent, to become slightly jammed between the rails, but not sufficient to stop its way, so that to all appearances the apparatus simply ran very slowly. This difficulty was, of course, soon overcome by planing away about ¼ inch from the inside of the rails. Then various trials with different forms of lubrication for the runners showed difficulties with this method, and resulted in the application of small wheels to the sides of the boat in place of the oak runners. The track itself was also altered, as it was found that the "take off" at the lower end was rather too steeply inclined and detracted from the speed. On June 8 the first trials were made with a man in the boat, and several fairly successful descents were made, both by Mr. J. T. C. Moore Brabazon (who has kindly given me most valuable assistance in these trials) and by myself. The size of the aeroplanes used on this occasion was insufficient to make a good glide, the total weight of the apparatus amounting to some 270 lbs., and the area of the aeroplanes (each 12 ft. by 5 ft. 6 ins.) to only 132 square feet. It was considered desirable to try the apparatus with this small aeroplane, with the object of testing the strength of all parts, and in this respect the results were most satisfactory. The boat, consisting of rough boards and battens screwed and nailed together, covered with canvas, stood a lot of very rough usage, and scarcely suffered at all from its plunges into the water. The aeroplanes were of thin cambric, stretched on bamboos of about 1½ ins. diameter at the butt ends. These were fixed to the boat, but otherwise not stayed or trussed in any way; and though they bent upwards considerably during the descent through the air, proved to be amply

Ready to Start. *Photo by Russell.*



In Mid Air. [*Photo. by Russell.*

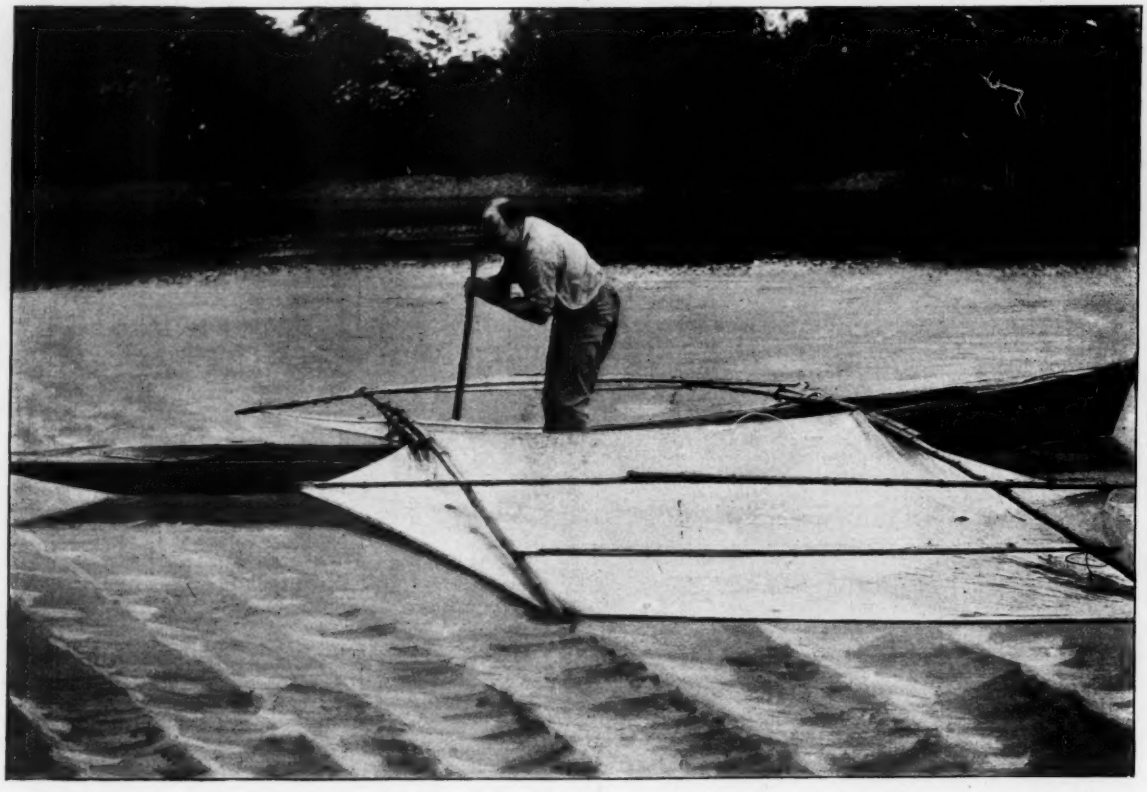


Another Glide. [*Photo. by Russell.*

XUM

strong enough for the work. By constructing the wings on this principle, instead of so staying them as to be rigidly horizontal, an advantage was gained in that while on the track the ends were not caught by any side wind, and yet, while supported in the air, a considerable diedral angle was formed which gave the desired transverse stability. On June 13, some larger aeroplanes were fitted. These were of hexagonal shape (being, in fact, constructed of old man-lifting kites), and were each of 118 square feet area. The arrangement may be seen in the last photograph. The lower end of the track had now been altered by removing the end support so as to allow the ends to droop. This is shown in the two photographs of the apparatus in the air, the boards having sprung back into the horizontal position after having been depressed by the weight of the boat. As the boat left the track, it was canted forward so that it shot downwards into the water too abruptly to make a good glide. There was, moreover, on this occasion a considerable head wind, which often interfered to some extent with the apparatus attaining a good speed, but which was not found to be so serious as might be thought. The usual time of descent from the top of the track to the take-off was just 3 seconds, being sometimes extended to 3½ seconds. On June 18 further trials were made, after a number of minor improvements had been effected. The lower end of the track was now rigidly supported and set so as to be exactly horizontal. A triangular "beak" of 18 square feet was spread in front of the same hexagonal aeroplanes, and some fairly successful glides were made, although, of course, the weight per area (1·24 lbs. per square foot) was still very excessive when compared to the proportions which previous experimenters with aeroplanes have applied.

Now that the general arrangement and practical working of the apparatus has been well tested, it will be possible to make more exact trials. It is proposed to fit on an upper aeroplane and other additions to make the total supporting surface up to some 430 square feet, and it then seems probable that we may be able to make some useful glides, full accounts of which I hope to send in for the next number.



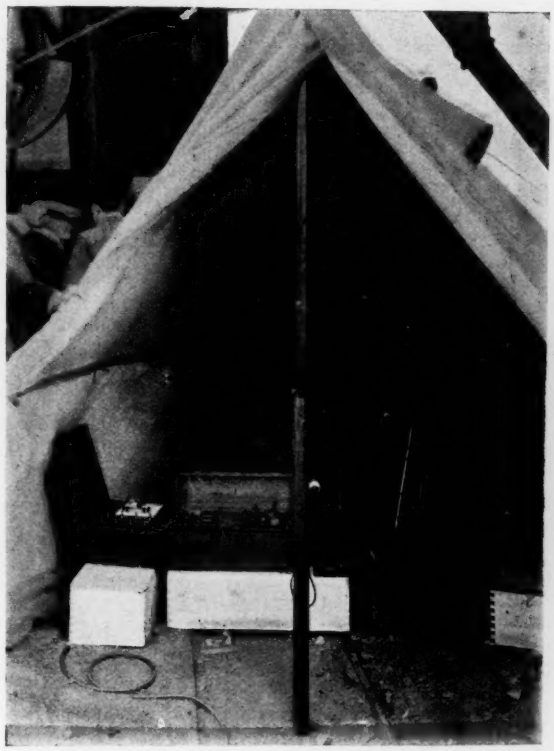
Paddling Ashore After Descent. [*Photo by Russell.*

CHICAGO is considering a new machine to mend the holes which all too frequently make their appearance in asphalt streets. A committee has gone to Pittsburg from Chicago to test the device, and if it proves to be able to do what is claimed for it, it will probably be adopted in other cities besides Chicago. Asphalt mending as it is done at present is both a tedious and expensive job, and a machine which would do good work automatically would find a ready field.

Electrical Ore Finding.

Prospecting by Telephone.

IN the early part of June, Professor Silvanus Thompson, F.R.S., delivered a kind of informal lecture on the Daft-Williams method of locating metalliferous deposits by means of electricity; and the system, which has been the subject of investigation for some time, may now be regarded as having passed from the uncertainty of experiment into the sphere of practical usefulness. Its usefulness has some limitations, some of which Professor



The Apparatus. *Photo by Burrows.*

Silvanus Thompson indicated. It depends for its success on the difference in electrical conductivity displayed between the lode of metal which it is desired to locate and the soil in which the lode is found. Therefore, although the system has been undeniably successful in locating veins of galena and of zinc blende, it does not follow that its success would be equally marked in locating other metals existing in other matrices; and it is by no means certain that the results could distinguish between a small thickness of rich ore and a number of stringers containing an equal amount of ore so distributed as to be commercially worthless. Still, the system is capable of showing great development; it is at present by no means a mere scientific curiosity; and even if it were, it is well worth attention.

We may best begin its description by an illustration. If a flow of electricity were to take place between two points at the top and bottom of this page, the electric flow would not take place in a single straight line, but would arrange itself in a number of lines with a greater or less resemblance to the lines of force between the poles of a magnet. But if on the page a bar of metal were laid, then the position of these lines would be disturbed—as a log in a pond would disturb the concentric ripples that a stone thrown into the pond's middle would otherwise produce. Similarly, if we cause a current to flow between two points on the earth's surface, a field of force in the earth's crust is formed; and, as Sir William Preece showed some twenty years ago, the lines of flow of the field can be studied with a telephone circuit connected to earth by portable electrodes. In Messrs. Williams and Daft's apparatus, the two transmitting electrodes (between which the current is to be sent) are earthed usually about 100 yards apart. The circuit in which they are the two points is fed by an induction coil which can deliver a very heavy secondary discharge into

Photo by Burrows.
Listening to the Telephonic Communicators.

a glass condenser. Two spark gaps—in series and in parallel—are inserted in the circuit. The breaks are of two types; one of the pendulum type, and one which is designed to give a "make" of any desired length and a break of unusual abruptness. The receiving (or telephone) circuit, which is to explore the lines of force created, consists of two telephone receivers, each of 500 to 900 ohms resistance, connecting to the exploring electrodes through a series of parallel switch.

While the current passing between the transmitting electrodes is suffering its "make and break," the telephones attached to the other or receiving electrodes, which are immersed in the soil about seventy feet apart, enable the investigator to "hear" the current as it passes. It sounds in the telephone receiver like the tap of a woodpecker, and it can be heard even when the two telephone electrodes are immersed in the earth several miles away from the immersed transmitting electrodes. In practice, it is not usual to explore at distances more than half a

XUM

mile away from the transmitting electrodes. If the field is entirely uniform, then the telephones will show, by the sounds of the tapping in them, that the direction of the lines of flow of the current is approximately in accordance with the theoretical diagrams as shown in text books.

Now we come to the question of the variations from the normal, caused by underground deposits of metalliferous bodies. Lodes are electrically divided into two classes, those which are better conductors than the enclosing rock, and those which are, comparatively speaking, insulators. A good conducting lode changes the shape and intensity of the normal field in a remarkable manner—elongating it in the direction of the strike. Waves passing into the lode at great depths are brought up to the surface. Hence, over the apex of the lode there is a concentration of energy and a corresponding increase of the sounds in the telephones when in the neighbourhood of the lode. In this way the position of the lode is easily ascertained, and, on exploring with the receiving electrodes further and further away, no sounds are heard whatever, except over the path of the lode. By moving the electrodes, a point is found where the sound suddenly ceases in some cases, but is again audible on moving the electrodes a little further. This point of equipotential and consequent silence occurs when the electrodes are so placed that the apex of the lode is midway between them. Absolute silence is not invariably attained, but in the case of conducting lodes, a diminution of sound always occurs. If the operator is nearer to the transmitting base and is receiving some of the normal waves which are travelling on and near the surface at an angle to the direction of the lode's strike a cross field is observed when the lode is between the electrodes, and the telephones give broken and discordant sounds. With lodes which act as insulating bodies, the field is never elongated, but possesses its normal shape. The waves, on encountering the lode, are brought to the surface of the ground on account of their inability to pass through, and, consequently, are all concentrated in the space between the apex of the lode and the earth's surface. When the telephone electrodes—being moved across the field at right angles to the direction in which it is expected the ore bodies strike—arrive at a point over a lode of this kind the increase in sound is sudden and intense, as might be expected when we consider the great depths from which the insulating body causes the waves to be brought.

There are many other ways of examining and testing the lie of veins and lodes; and the skilled investigator is able, by a suitable restriction of the electric field and by adjustment of the potential of the transmitting current, to apply tests for the depth of the lode. Much has probably yet to be done in elaborating the possibilities of this method, and in simplifying or codifying its applications, so as to render it accessible in ordinary use; but of its use and of its interest no doubt need be entertained.

THE Japanese explosive, Shimose, has been said to be more powerful than either dynamite or guncotton. Shimose does not explode on percussion, or by fire, and is not injured by wetting. When it is exploded, by a charge of fulminite, it tears a hole greater than would result from the use of a similar quantity of dynamite, and, unlike that substance, its force is equally exerted in all directions.

NOTES.

ASTRONOMICAL.

The Solar Parallax.

AT the last meeting of the Royal Astronomical Society on June 10, Mr. A. R. Hinks read a paper on the determination of the Solar parallax from the measurement of photographs of the minor planet Eros, taken at the Cambridge Observatory, and at several other co-operating observatories. The value obtained agreed very closely indeed with that secured several years ago by Sir David Gill from observations of the three minor planets—Victoria, Iris, and Sappho; Mr. Hinks getting 8″·796, as against Sir David Gill's 8″·802. At the Académie des Sciences of Paris on June 6, M. Bouquet de la Grye gave the result of the measurement of the photographs of the transit of Venus, 1882, obtained by the French expeditions. These gave values varying from 8″·786 to 8″·792.

* * *

An Interesting Variable Star.

Number 6760 of Chandler's Catalogue of Variable Stars is a 4th magnitude star, bearing the name of Kappa Pavonis. Its variability was discovered by Dr. Thome in 1871, and it has been the subject of a very careful scrutiny during the last thirteen years by Dr. A. W. Roberts, of Lovedale, South Africa. The period of variation is about nine days, and the range from magnitude 4 to magnitude 5·5. The period of increase is slightly shorter than the period of decline—M − m = 4·71 days, whilst m − M = 4·38 days; but when all the observations are brought together and compared with the ephemeris, it is seen at once that there is a small systematic variation in the length of the period—a variation which goes through all its phases in the course of eight years. This would be explained if we regarded the variable as travelling in an orbit seventy times as large as that of the earth, in a period of eight years, implying that it was revolving round an invisible primary of a mass 5000 times as great as that of the sun. It is, of course, possible that this secular variation may be accounted for in other ways, and may even be purely observational in character; but it suggests that the star should make a very promising subject for the most careful heliometer and spectroscopic observations.

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The Stars of Secchi's Third Type.

The distinguishing feature of the spectra of these stars—"Antarian" stars, as Sir Norman Lockyer calls them, after one of the brightest examples of the type—is the system of seemingly dark flutings, sharp towards the violet, and shading off towards the red end of the spectrum. Until quite recently the origin of these flutings has remained without any satisfactory explanation, and indeed, the question has been debated as to whether the spectrum should not be regarded as one consisting partly of bright flutings fading towards the violet, rather than as one consisting wholly of absorption flutings fading towards the red. Professor A. Fowler, of the Royal College of Science, South Kensington, in a paper recently communicated to the Royal Society, appears to have given a satisfactory solution to this long-standing problem. He finds that the flutings are truly absorption effects, and that they correspond within the possible limits of error with the flutings of titanium. The flutings in question come out in the arc spectrum, if a liberal supply of titanium oxide be used with a very long arc. As yet Professor Fowler has not been able to decide completely whether the flutings are due to the vapour of titanium itself or to that of its oxide. It is interesting to note, especially in view of the correspondences which Professor Hale has found in stars of the fourth type to the lines typical of the spectra of sunspots, that Miss Clerke last year, in her book "Problems in Astrophysics," definitely

suggested the enquiry as to the presence of titanium and its usual associate, vanadium, in stars of the third type on account of the importance of those two elements in sunspot spectra.

* * *

The Fifth Satellite of Jupiter.

Miss E. E. Dobbin, whilst a student at the Yerkes Observatory in the summer of 1902, undertook, at the request of Professor Barnard, an investigation of the relative worth of the orbits deduced for the fifth satellite of Jupiter by Dr. Cohn and M. Tisserand. Later, she undertook a complete discussion of the problem, using only the observations of Professor Barnard, in order to secure greater homogeneity. The observations ranged from 1892 to 1903 inclusive, and her discussion gives the following elements of the orbit:—

$(a) = 47''{\cdot}961$
$(e) = 0{\cdot}00308$
$dP = 2^{\circ}{\cdot}429$ daily, or $887^{\circ}{\cdot}20$ yearly.
$v = 227^{\circ}{\cdot}10$, $v - L = 193^{\circ}{\cdot}80$
$n = 722^{\circ}{\cdot}6316$ daily

The most noticeable feature of these results is the smallness of the eccentricity as compared with that obtained by Dr. Cohn and M. Tisserand. Miss Dobbin is doubtful whether the change is real, and denotes a progressive perturbation which will end in reducing the ellipse to a perfect circle, or is an accidental one, and the question can only be decided after another decade of observation or more. The satellite was noted to be ahead of its ephemeris place in 1902 and 1903. This was due to the initial value of the longitude of the node being too small by $0^{\circ}{\cdot}7$, or $1'{\cdot}4$, by which amount the orbit should be moved forward.

* * *

Orbit and Spectrum of Delta Orionis.

About four years ago M. Deslandres found that Delta Orionis varied in its velocity in the line of sight, or, to use a shorter phrase suggested by Dr. Hartmann, was an "oscillating" star. M. Deslandres deduced a period for it of 1·92 days, and a very eccentric orbit. The star was then placed on the observing list at Potsdam, and Dr. Hartmann, having obtained more than 40 plates of its spectrum, has carried out a new discussion of its orbit; for which he finds the period, 5 days 17 hours 34 minutes 48 seconds $\pm$ 17 seconds, and an eccentricity, 0·10334. In other words, the orbit is nearly circular. But the striking discovery lies here: whilst the lines in general are characteristically hazy, and show periodical displacements, one line, the K line of calcium, though always exceedingly weak, is always narrow and sharp, *and takes no part in the periodic displacement shown by the other lines.* Dr. Hartmann concludes that this K line cannot be due to the spectrum of the fainter component of the star, but that a cloud of calcium vapour must lie between us and Delta Orionis, producing this absorption. An analogous phenomenon was displayed by Nova Persei at one time in 1901, and Dr. Hartmann notes that the component of the solar motion for both Delta Orionis and Nova Persei almost exactly corresponds to the velocity indicated by these stable calcium lines, implying that in both cases the intervening calcium clouds are almost completely at rest relatively to the stars from which the elements of the sun's way have been computed. The distance from us of this cloud cannot be determined, but its extent might possibly be ascertained by observations of the K line in neighbouring stars.

* * *

Sunspot Variation in Latitude.

An interesting discussion took place at the last meeting of the Astronomical Society on June 10 on the above subject. Dr. W. J. S. Lockyer recently communicated a paper to the Royal Society, stating that "Spörer's Law of Spot Zones was only approximately true, Spörer's curves being the integrated result of two, three, and sometimes four 'spot activity track' curves, each of the latter falling nearly continuously in latitude." The Rev. A. L. Cortie and Mr. Maunder both read papers on the same subject, the former showing that the limiting latitudes for large sunspots rose from minimum to maximum instead of falling in the manner described by Dr. Lockyer, and that the "spot activity tracks" of which he spoke had no real existence. Mr. Maunder showed that the Greenwich Sunspot Results for the last thirty years fully confirmed Spörer's Law, and proved that there was but one general zone of spot activity in each hemisphere. When every separate spot group was plotted down according to its solar latitude, it was seen at once that there were no such separate downward moving "spot activity tracks" as Dr. Lockyer had described.

* * *

The Royal Observatory, Greenwich.

The annual report of the Astronomer Royal to the Board of Visitors was read on Saturday, June 4. The year's record had been destitute of sensational incidents, the most noteworthy being the great magnetic storm of October 31-November 1. But the report records the completion, or near approach to completion, of a number of most important enterprises. The publication of the first volume of the "Astrographic Catalogue" was noticed in "KNOWLEDGE" last month. The photography for the Greenwich section of the "Chart and Catalogue" is complete, and the progress made in the observation of the reference stars for the astrographic plates has been so satisfactory that it is expected that the work will be completed next year. The revision of "Groombridge's Catalogue for 1810" and the determination of 4000 proper motions therefrom are complete, and the results are about to be published. Considerable progress has been made with the measurement of the photographs of Eros, taken in 1900 and 1901 for the solar parallax. The rainfall of the year 1903 was 35·54 inches, the heaviest ever recorded at Greenwich during the calendar year, but the amount of sunshine registered was a little above the average, and the number of observations made with the transit circle suffered no diminution through the unprecedentedly wet character of the year.

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The Smithsonian Expedition to observe the 1900 Solar Eclipse.

The Smithsonian Institution sent an expedition under Professor S. P. Langley to observe the total eclipse of May, 1900, at Wadesboro, S. Carolina, which was especially interesting in view of the fact that its leader had observed the famous eclipse of 1878, two complete solar cycles earlier, at Pike's Peak. Professor Langley observed with the same 5-inch telescope that he had used on the former occasion, and says that "the inner corona was filled with detail, but far less sharp and definite than he saw it on Pike's Peak in 1878. He could not identify any connection between the coronal structure and the presence of prominences, while his impression was that the details contained more ogival curves than straight streamers. Having in mind the wonderful structure seen with the instrument in the clear mountain air 22 years before, the impression was a disappointing one." This absence of connection between the prominences and the coronal structure was not borne out either by visual or photographic observations at other stations or by the photographs taken at his own camp, for in his general summary and conclusion Professor Langley says that "large prominences were present, and these appear to have been associated with regions of coronal disturbance." He goes on to say that "the equatorial streamers were followed on photographs to nearly four solar diameters, and were then lost by reason of diminished intensity rather than as appearing to end." This coronal extension, though not so great as that photographed by Mrs. Maunder in India in 1898, seems to be greater than any secured in any of the other expeditions in 1900. The feature, however, in the Smithsonian Expedition which excited the most interest was the use of the bolometer, and though its results were to a great extent negative in character, they were no less important. Professor Langley says: "In the bolometric observations the heating effect of the inner coronal radiations was recognised and found unexpectedly feeble. The results seem to indicate a comparative weakness of the infra-red portion of the coronal spectrum, alike inconsistent with the hypothesis that it radiates chiefly by virtue of a high temperature, or acts chiefly as a reflector of ordinary sunlight. This, taken in connection with the appearance of the corona, seems to support the hypothesis that the principal source of its radiations is of the nature of an electrical discharge. The well-known polarisation of its outer portions, and the presence of faint dark lines in the outer coronal spectrum, announced many years ago by Janssen and confirmed by the photographs of Perrine in the eclipse of 1901, prove that a small portion of the coronal radiation is due to reflected photospheric light. But the photographs of the

XUM

coronal spectrum by Campbell in 1898, and Perrine in 1901, indicate that the principal part of the coronal light is not reflected sunlight. Many are disposed to believe the main source to be the incandescence of particles due to the proximity of the hot photosphere, but so far as the writer is aware the spectroscopic evidence is equally in accord with the hypothesis of a glow electrical discharge. An example of such a discharge is found in the aurora of the terrestrial atmosphere, but while we can hardly deny the possibility of its existence in the case of the sun, the above observations do not seem to the writer to be conclusive on the point." It seems of the highest importance that bolometric observations should not be neglected in the eclipse of 1905.

ORNITHOLOGICAL.

By W. P. Pycraft, A.L.S., F.Z.S., M.B.O.U., &c.

Breeding of the White Stork at Kew.

The pair of white storks (*Ciconia alba*) at the Royal Botanic Gardens, Kew, have again succeeded in hatching out nestlings, this being the third successive year. In 1902, five eggs were laid, but from those only three proved fertile, and only one nestling was ultimately reared. Last year torrents of rain put a speedy end to the domestic bliss of these interesting captives, the young being drowned in the nest. To avoid a similar catastrophe this year, a roof has been erected above the nest, which stands on a mound between the trunks of two large trees. In spite of every care, however, on the part of the keepers, and the assiduous attention of the parents, only one of the four birds hatched out now remains. This, it is to be hoped, will survive.

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Guinea-Fowl in a Roman Dust-heap.

A find of considerable interest and importance has just been made at Silchester in the course of the excavations being made there by archæologists. The find in question was the tarso-metatarsus of a guinea-fowl, which had recently been recovered from a Roman kitchen midden. That this bird was highly prized we may gather from the fact that around the leg, during the bird's lifetime, a bronze ring had been placed, and the remains of this, much corroded, encircled the bone when brought to the Natural History Museum for identification.

The value of this discovery lies in the fact that though the guinea-fowl is believed to have been originally introduced by the Romans, no similar remains of this bird have hitherto been found in this country. That our domesticated guinea-fowls of to-day are the descendants of those introduced by the Romans is hardly probable, though at what date they were re-introduced into our islands, or even into Europe, is unknown.

* * *

Hybrid Pheasants.

The remarkably fine series of hybrid pheasants in the collection of the Duke of Bedford was exhibited by Dr. Günther at the meeting of the Zoological Society on June 9. All had been killed, at various times, in the coverts at Woburn, and were the results of crosses between the many different species which have from time to time been liberated there. Some of these birds were of great beauty, but unfortunately they presented characters so subtly blended as to make it impossible to do more than hazard a guess at their parentage. That results of considerable scientific value would accrue from a series of properly conducted experiments made with a view to reproducing the crosses which these birds suggest, there can be no doubt. It is with a view to stimulate some such experiments that we now bring this matter before those of our readers who have the necessary space and material at their command.

Mr. J. L. Bonhote, who is now engaged in a series of extremely valuable experiments in the hybridization of ducks, in commenting on this exhibition, remarked that, judging from his experience, hybridization tended to reduce vigour, and that hybrids were either markedly *more*, or conspicuously *less*, ornamented than their parents. Further, he insisted that the less coloured birds were the more fertile, and the more coloured less fertile. As a word of warning in determining the origin of wild hybrids, he remarked that hybrids tend to produce the characters of species which were *not* the parents.

* * *

The Eggs of Darwin's Rhea.

The Hon. Walter Rothschild exhibited at the Ornithologists' Club on Wednesday, June 15, the first eggs of Darwin's Rhea laid in this country. They were laid in Tring Park, and were, he remarked, relatively larger than those of the Common Rhea, though the latter is much the larger bird. When freshly laid they were of a bright green colour, but rapidly faded to a parchment hue. In their green colour and more polished surface they further differ from the eggs of Rhea Americana.

* * *

Twite Breeding in North Devon.

Mr. Pearson exhibited at the meeting just referred to the nest and eggs of the Twite (*Linota montium*). This nest was found on the ground under a low bush on May 5. The parents were not taken, but were watched within 20 yards of the nest.

* * *

Ye ow-legged Herring Gull at Dover.

Mr. C. N. Rothschild, at this meeting of the Club, announced the fact that he had seen what he had no doubt was the yellow-legged Herring Gull (*Larus cachinnaus*) flying in Dover Harbour on April 18. The conspicuous light yellow legs of this bird were plainly seen.

PHYSICAL.

An Apparatus for Preventing Sea-Sickness.

An ingenious apparatus has just been brought out in Hamburg, Germany, by Mr. O. Schlick, a naval engineer. This apparatus is designed both to augment largely the period of oscillation of the rolling movement of a ship and to diminish at the same time the amplitude of oscillation, both effects being based on the gryoscopic action of a fly wheel installed on board and performing a rapid rotation. The vertical axis of the apparatus is enabled to perform a pendulating movement in the central plane of the ship. The latter, on account of the rapid continuous oscillations of the wheel, is rendered insensitive to the effect of wave-motion, so as to eliminate practically any rolling movement. As the effect exerted by the device is rather energetic even with the smallest lateral oscillations of the ship, there will be no propagation of the motion. Thus the production of any strong balancing movement will be avoided, in contradistinction to the effects observed in the case of drift keels, which are not brought to bear before the rolling movements have assumed a high intensity. As regards the underlying principle of the apparatus, it should be remembered that a rotating body will oppose to any inclination of its axis a resistance the higher as the rotation is more rapid, and the weight of the body more considerable. As the forces producing the rolling movement of a ship need not be of an excessive intensity (in fact it is well known that 20 to 25 men running in proper time from one side of the deck of a large steamer to the other will produce rather considerable rolling movements of the ship), the weight of the apparatus need not either be very high. Mr. Schlick calculates that in the case of a ship 6000 tons in weight, a 10-ton fly wheel, 4 m. in diameter, will be quite sufficient. There will therefore be no difficulty in using the Schlick apparatus on ships of moderate dimensions, such as, for instance, cross-Channel steamers, where they will largely contribute to augmenting the comfort of the passengers.

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On Wireless Telephony by means of Hertzian Waves.

In a recent issue of *La Energia Eléctrica*, Madrid (May 25, 1904), Mr. G. J. de Guillén Garcia records some interesting experiments made by him, in conjunction with his son. In

connection with some wireless telegraphy researches, the son of the author happened to note that in the telephone of the Tommasi coherer, located at the receiving station, there was a "sound difference," which varied in accordance with the air-gap in the interrupter of the Rhumkorff apparatus. This suggested the idea that a similar apparatus would be capable of transmitting the human voice to a distance without the agency of the wire. The experiments had to be put off for some time because of the lack of a suitable outfit; but the author was eventually enabled, through the courtesy of Professor Marcel, of the Barcelona Seminary, to carry out his idea. The experimental arrangement is a rather simple one. At the transmitting station there is a Rhumkorff apparatus 3 cm. in spark length, as well as the necessary oscillator, a small antennæ, and an earthed conductor. Between the transformer (*i.e.*, the Rhumkorff coil) and a small battery of Grenet cells, there is a special microphone acting both as manipulator and as interrupter. The automatic interrupter of the induction coil is stopped, while the condenser is used for enforcing the oscillator spark. At the receiving station, there is a Tommasi coherer, connected to the receiving antennæ, and the earthed conductor. In a telephone receiver, the noise produced by the Hertzian waves on traversing the coherer is noted. On approaching the mouth of the microphone and singing or speaking, every sound vibration will be attended by an interruption in the passage of the electric current through the primary circuit of the transformer, the number of sparks in the oscillator thus being varied. The underlying principle shows, therefore, some analogy with the mechanism in an ordinary telephone. Any results so far obtained in the reproduction of singing are said to be quite satisfactory, whereas the rendering of language leaves much to be desired. The feeble point seems to be the difficulty of designing a microphone of sufficient intensity. Mr. Garcia, it is true, has remedied the imperfections of his apparatus to a certain extent by using a condenser and augmenting the potential difference. This, however, could not be driven too far, lest electric arcs be formed.

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On the Chemical Effect of Cathode Rays.

Dr. E. Bose, of Göttingen University, has for two years past made a close investigation of the simplest possible case of a chemical action of cathode rays, with a view to ascertaining whether or not the chemical conversion due to the rays is a purely electro-chemical phenomenon according to Faraday's law (see *Physikalische Zeitschrift*, No. 12, June 15, 1904). A solution of caustic potash, saturated in the hot state, was exposed for a long time to the effect of cathode rays in a convenient outfit allowing of a large electrolyte surface—in fact, about 200 sq. cm., being radiated upon intensely, when a reduction, attended by the formation of hydrogen, was noted. The amount of electricity absorbed by the electrolyte was measured with the aid of a hydrogen voltmeter under reduced pressure, this electricity being drawn off through a platinum electrode sealed into the bottom of the testing tube. As the hydrogen present in the vacuum where the discharges took place was partly dissociated into hydrogen and oxygen, a mixture of hydrogen and oxygen, containing hydrogen in excess, was withdrawn by means of the mercury air pump, and, after the gases due to this dissociation were eliminated by an explosion, the hydrogen in excess could be measured, and its pure condition confirmed. Now, in the case of the chemical effect of the cathode rays following Faraday's law—*i.e.*, being a purely electro-chemical phenomenon—the amount of hydrogen derived from the vacuum should be strictly the same as the one evolved in the voltmeter. A high degree of accuracy, it is true, was not to be anticipated, on account of the smallness of the effects and amounts of electricity in question, but the invariable result of the experiments was in opposition to the foregoing hypothesis, 1030 and even more times the amount obtained in the voltmeter being derived from the vacuum. There must, therefore, be, besides the electro-chemical action, another chemical effect of cathode rays, due obviously to the kinetic energy of the cathode ray particles, this hypothesis being borne out by the theoretical considerations of the author. It is shown that, in the most favourable case, an amount of hydrogen even 1600 times the electro-chemical amount would be obtained. But it should be remembered that, in most cases, the greater part of the kinetical energy of the rays is simply transformed into heat.

New Self-Recording Barometer.

The new self-recording barometer which Mr. W. H. Dines has designed, and which is made by Mr. J. Hicks, of Hatton Garden, grapples in an original and satisfactory way with the two problems of the recording barometer—the difficulty of registering very small differences, and of ensuring a high degree of accuracy. The curve traced by the recording pen is accurate to the one-two-hundredth part of an inch. The ends aimed at are attained by reducing the friction between all moving parts, and by the ingenious device of an automatic correction for temperature. The pen moves with a float in the lower cistern (the motion being multiplied by a lever); and this float is in the form of a hollow cylinder floating mouth downwards in the mercury. A rise of temperature lowers the level of the mercury in the lower cistern; but at the same time it makes the float swim higher in the mercury, because the air in the hollow cylinder expands with the same increase of temperature. The volume of air in the hollow float is so adjusted as to make the compensation perfect. Another useful device is the addition of what we may call a stationary pen, which is fixed to the frame, and which draws a line of reference on the reel of paper wound on the clock drum of the barometer. Any error in spacing the chart of the drum, or any carelessness in placing the chart on the drum, is thereby rectified, since this line can be taken as the zero line.

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ZOOLOGICAL.

The English Stoat.

THE English stoat, according to Captain G. E. H. Barrett-Hamilton, differs from the stoat of Scandinavia—the true *Mustela erminea* of Linnæus—by having the tail coloured uniformly all round, instead of with the under surface much lighter than the rest. Moreover, it does not usually turn white in winter. Consequently, it is regarded as a distinct race—*Mustela* (or *Putorius*) *erminea stabilis*.

* * *

Habits of African Fishes.

Some very interesting observations, based on specimens kept in the Aquarium, on the habits of many species of fish from the Nile are recorded in the Director's report of the Zoological Gardens at Giza, near Cairo, for last year. Many of these refer to the long-snouted fishes of the family *Mormyridæ*, all of which are peculiar to the African rivers, and some of which have a muzzle comparable to the trunk of an elephant. In a natural state all these fishes appear to be thoroughly nocturnal, but in captivity they soon learn to move about during the daytime, when they will search for the chopped worms on which they are fed. Specimens of the long-nosed species, known as *Mormyrus kannume*, generally spend the day lying quietly at the bottom of the tank, but after nightfall become very active, searching energetically after food. When a light is thrown on them their eyes shine in a very remarkable manner, sometimes appearing white and sometimes gleaming red. They have also a curious habit of swimming tail-first.

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Classification of Fishes.

Considerable modifications of the generally-accepted classification of fishes are suggested by Mr. C. T. Regan in the May number of the "Annals and Magazine of Natural History.' The sturgeons and their extinct relatives are, for instance, regarded as the most primitive representatives of the bony fishes, and from this group is derived the bisher of the Nile and the other members of the now nearly extinct section of fringe-finned ganoids; while from the latter are descended the lung-fishes (such as the Queensland baramunda and the South American and African lung-fishes), which have generally been regarded as constituting a distinct order by themselves.

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Alligators and Crocodiles.

A remarkable display of ignorance and inaccuracy has been recently displayed by a correspondence in the *St. James's Gazette* with regard to the alleged occurrence of alligators in

Australia. The first writer stated that these saurians abounded on that island continent; this was derided by a second, who asserted that alligators were confined to America. A third correspondent correctly pointed out that an alligator is also found in China, but made the absurd mistake of asserting that the Australian representatives of the crocodilian order belong to the genus *Tomistoma*, represented solely by Schlegel's gharial of Borneo and Malacca. The strange thing about discussions of this nature is that people will rush into print without consulting some standard work on natural history (such as the "Royal Natural History"), or, still better, the invaluable series of British Museum "Catalogues," which, although they afford an absolute mine of authentic information, seem to be quite unknown to the amateur zoologist. It should, however, be mentioned that the term "alligator" has a double signation —a popular and a technical—either of which is perfectly legitimate. In the popular sense it is applied to all the broad-nosed crocodilians (in the same manner as rooks are generally called crows), in the zoological sense it is confined to two or three species of the former, respectively inhabiting North America and China, unless, indeed, the caimans of South America are included under the same title.

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Some Giant Fossil Reptiles.

One of the most gigantic of known fossil reptiles has been hitherto so generally known as *Brontosaurus* that it is somewhat a shock to find that this term, according to Mr. E. S. Biggs, of the Field Museum at Chicago, must give way to the earlier *Apatosaurus*. Of this monster, which attained a total length of something like sixty feet, two practically complete skeletons are known, one of which is preserved in the Field Museum, and the other in the Museum at Yale College. Of not less interest are the skeletons of giant toothless pterodactyles (*Pteranodon* and *Nyctosaurus*) which have been recently set up in American museums, some of these having a span of wing of fully fifteen or sixteen feet. The former type, which by some authorities is believed to have had a curious backward prolongation of the skull, is also peculiar in possessing a ring of bones in the eye, like birds. Pterodactyles probably seized and held their prey solely by their beak or jaws, but some of those dinosaurs, or giant land reptiles, which habitually assumed the upright posture seem to have used their fore-limbs for this purpose. For instance, the relatively small *Ornithomimus altus* appears to have raced after its prey, which was firmly gripped by the long and powerful claws of the front paws.

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A Horn Exhibition.

At the exhibition of sporting trophies recently held at Berlin, the number of specimens of deer antlers displayed was very great; many of them being remarkable for their large size or symmetry of form. Kaiser Wilhelm was one of the exhibitors. Medals were offered for the finest specimens.

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Sale of Great Auk's Egg.

A fine specimen of the egg of the great auk was sold the other day at Stevens's auction rooms for two hundred guineas, or two-thirds the price realised by an example sold a few years ago. In 1838 this egg was bought for £2, while in 1869 it was sold for £64. In 1898, after it had long been supposed to be broken, it was found among the effects of the daughter of the purchaser. In connection with this subject, it may be mentioned that a number of skulls and other bones of the great auk have been recently discovered in an old rubbish heap at Caithness; one of the skulls being now exhibited in the Geological Department of the Natural History Museum.

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Papers Read.

At the meeting of the Zoological Society held on May 17th, there was exhibited, on behalf of the Duke of Bedford, a sketch of a hind and fawn of Père Davids deer (*Elaphurus davidianus*) from Hainan—a species previously believed to be now represented only by specimens living in European menageries. The fifth of Sir C. Eliot's series of articles on the naked-gilled molluscs of Zanzibar and East Africa was read; as was also a paper by Mr. Boulenger on a tree-frog from British Guiana which carries its eggs on its back. Mr. Beddard contributed notes on the anatomy of certain snakes belonging to the python family; and Dr. G. S. Brady furnished an account of water-fleas and other minute crustaceans collected in Natal.

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Flying Fish.

"Quill Pen" writes from Las Palmas: "In your number for April I notice a note on flying fish. I have, during the last year or two, frequently watched them as opportunity offered in the South Atlantic and Indian Oceans, and at times followed the flight of one through a glass, and am inclined to think the 'wings' may occasionally be used as organs of flight. When using them as such the fish appears to assume a more vertical position, resuming the horizontal position again when using them as a parachute. I have seen this vertical position assumed twice during a flight, in both of which progression appeared to be aided by distinct movement of the wings."

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The Nautilus and Flying Fish.

Mr. George Henslow writes: "In a note on p. 68 of the April number are some remarks upon these creatures. I watched both as carefully as possible through an opera glass on board ship, and the appearance of the Nautilus at a distance was that of a white, square sail above the water. As the vessel approached, the 'sail' turned out to be the shell seen endwise. How any motion of the expanded fins of the flying fish may be effected, it was not possible to observe; but the fish can do more than skim in a straight line. They can rise over an approaching wave, and dart to the side if necessary.

REVIEWS OF BOOKS.

The Analysis of Colour.—The value of Professor A. G. Green's "Systematic Survey of the Organic Colouring Matters" (Macmillan) resides in its completeness and its terseness. It is not a book to be read in an armchair by the pleasant light of the study lamp; but a manual of severe facts, formulæ, and symbols which present to the chemist, the manufacturer, the calico printer, the dye merchant, and the patent agent every accessible means of reference to the composition of the vast array of synthetic colouring matters that are sweeping away, by virtue of their cheapness, the vegetable dyes. If we say sweeping away, instead of "swept away," it is because, as Professor Green reminds us, the sharp line of demarcation between the artificial and the natural organic dye-stuffs can no longer be maintained; and the artificial production of indigo and the new synthetic products in other groups of colouring matters are tending still further to obliterate the distinction. If, indeed, one general conclusion emerges salient from the tables and records of the organic colouring matters, it is that there is no finality in the chemistry of colour. The volume before us consists of two parts, in the first of which Professor Green deals with the raw and intermediate products of artificial colour manufacture, extending them so as to include the most recent methods and material; and in the second of which he edits a dictionary of the colouring matters, based on the German tables of Drs. Schultz and Julius, which indicates as briefly as is compatible with clearness the commercial and scientific names, the empirical and constitutional formulæ, the methods of preparation and employment, the patents, and the literature of each colouring matter. The first volume on these lines was published ten years ago. Since that date 59 of the 454 colouring matters then described have become obsolete. On the other hand, 300 new colouring matters have been added. These figures do not exhaust, even in a numerical sense, the change and development in colour manufacture. Another 16 must be added to the 695 artificial colours to embrace those which are in a transitional state, between the employment of natural dyes and the supersession of such dyes by new syntheses. But beyond and above these facts is the far more important one that in the manufacture of colour, no patent, no discovery, confers lasting profit on its discoverer or owner. A discovery in industrial chemistry is like a message sent by wireless telegraphy; it can be tapped by any scientist in the neighbourhood who is provided with the appropriate apparatus.

Consequently advancement and wealth in the manufacture of what we may for convenience call the "coal tar" dyes are to be secured not by any isolated success or happy stroke of fortune, but by continuous application of economical methods, by unceasing chemical research, and by the co-operative efforts of a school of chemists. It is because the German manufacturers have realised these facts and English manufacturers have not, that the rewards of the discoveries of Perkins' mauve, Hoffman's violet, A. G. Green's primuline, have not been reaped by England, where they were first made, but in the long run by the German firms who have applied to colour making the levers of trained research and organised equipment. It is for this reason that 90 per cent. of the patents in Professor Green's tables are of other than English origin.

In Praise of Gardens.—The most complete justification that we can find for Mr. John Halsham's "Every Man His Own Gardener" (Hodder and Stoughton) is in a passage from his Introduction: "If there be one pursuit that can be commended as a general recreation, a hobby good for all temperaments, ranks, and employments, it is gardening. It is a stand-by that will come in with its solid results to fill any hiatus in the progress of our loftier concerns. If a party go into the cold shade of Opposition, or a company into liquidation; if a book, a picture, a play be damned, it is good to be able to shut one's gates on the mad world, and find one's marrowfats podding, one's nectarines reddening, faithful to their master's hand, heartening him to survive the earthquake even as they have done. There is no vote of censure, no critical cat-o'-nine tails which can touch that part of his work; and if he cares to try the popular suffrage again, he may find that people who have trodden on his pearls are not by any means incapable of relishing his peaches." That is not only a piece of extremely good writing, but it expresses in the fittest terms the reason for the love which most good Englishmen have for their garden; and it is a sufficient indication of the charm of a charming book. If Mr. Halsham's book were only charming, that would not, perhaps, be, in the eyes of many people, either a sufficient excuse for its title, or a sufficient reason why they should buy it. But it is full of the most practical information on soils and tilths, cropping, seed-sowing, manures, pricking, the hotbed, plagues and pests, potatoes and pruning, cuttings and bulbs. It is a compendium for the amateur gardener of town or country, and it is delightful reading for all who love "the massy-bronzed pears on the south wall, and the cauliflowers paling from cream to pure white under the green tent of their leaves"; or "who balance the gay fulfilment of the sweet-pea with the green promise of the marrowfat."

Miss Eleanor Ormerod.—In the autobiography of "Eleanor Ormerod, LL.D." (John Murray), which is edited by Professor Robert Wallace, of Edinburgh, appear a number of Miss Ormerod's letters to Dr. Fletcher. In one of them she humorously suggests that surely it should be recorded of her that "she introduced Paris-Green into England"; and in that phrase is summed up much of the charm, the modesty, and the persevering usefulness of Miss Ormerod, her life, and her work. She was born nine years before the accession of Queen Victoria; and one might say of her, without fulsomeness or exaggeration, that she was one of the great women of the Victorian Era. Beginning with no greater advantages than a love for living things, she attained a position in which she ranked as one of the first economic entomologists of the day. For half a century she was a close student; for half of that time her Annual Reports and pamphlets on injurious insects and common farm pests were beacons which lit the path of a revolution in agricultural entomology. The real work that she did is known to thousands of people, and is to be found in her correspondence with entomologists and agriculturists all over the world. The less concrete summary of it may be inferred from the impression which she made on her contemporaries and co-workers. She was Consulting Entomologist to the Royal Agricultural Society, Lecturer at the Royal Agricultural College; medals were conferred on her by scientific societies, not of her own country alone, but France and Russia. She was an LL.D. of Edinburgh, and many foreign societies at home, in the Colonies, and abroad were honoured by her fellowship. Space forbids that we should attempt even a brief summary of the main features of her scientific achievement. For that we must refer readers to this admirable biography and autobiography, which reveals Miss Ormerod as she appeared to all who were privileged to know her, even for the briefest period, or in the most accidental way, as the kindliest as well as one of the cleverest and most modest women of our time.

Physical Deterioration. Logical and clearly put, Mrs. A. Watt Smyth's views on "Physical Deterioration, Its Causes and Cure" (London: John Murray), might also prove of great instructional value if the right classes of people could only be made to read them. But in attributing the deterioration in physique of the poorer classes of English people to life in towns and in suggesting as remedies for it a greater regard for personal cleanliness, a purer supply of air, milk and other food, Mrs. Watt Smyth comes perilously near the pitfalls of over-generalisation. As an instance of the snare into which this tendency to generalisation may lead, we may quote one extreme instance, while admitting that it does not injure the general argument in favour of leading a healthy physical life if proper physique is to be attained. "The physical and intellectual beauty of the ancient Greeks," says the author, "of which proofs innumerable have been handed down in their literature and works of art, resulted . . . from their public games"! Nothing is less proved or less probable than that the intellectual success of the Greek nation resulted from anything of the kind. If it were true, then we might expect the highest intellectual product of our time to arise from the ranks of those who win Sheffield Handicaps or appear in the incomparable acrobatic feats of the modern music-hall. To the intellectual and political success of the Greeks, their geo-political position was probably the first contributory cause; and their wise hygienic rules of life were a consequence of success already attained. Similarly, if the factory laws of Great Britain were perfect; if the abolition of primogeniture made small holdings likely; if a greater imaginative sense drove poor English people to fresh air and pastures new in the Colonies; if, as a race, we were more thrifty and less self-indulgent—then the national physique might improve and public games become a well-ordered rite. But none of these initial causes, whose absence we have indicated, is by itself the universal panacea for good health; and we must decline to believe that even continued residence in towns is the sole cause of national physical deterioration. But having thus pointed out what we think to be the chief defect of this book, that it takes things too much for granted, and argues from generalities assumed to be truths, we have nothing but praise for some of the "cures" suggested. Purer milk is one of them, on which legislation ought to insist with much greater emphasis; and the prevention of children's work in hours when they should be at school is a thing on which we should insist with much greater emphasis than Mrs. A. Watt Smyth has courage to do. The abolition of the half-timer, and the insistence that the years of a boy's or girl's education should be devoted to education alone—intellectual and physical—these are among the greatest remedies for the intellectual as well as the physical stagnation of the masses of the people.

Geology. Mr. W. Jerome Harrison's "Text-Book of Geology" (Blackie and Son) has reached a fifth edition. A valuable addition is a table showing the Range in Time of Invertebrate Fossils. This useful book has been otherwise revised and brought up to date in accordance with the most recent additions to our knowledge of rock formation.

Chronology. In "Astronomical and Historical Chronology" (Longmans, Green and Co.), Mr. William Leighton Jordan has set himself the task of showing reason for such a reformation of historical chronology as would bring it into accordance with the method of numbering the years B.C. which has been adopted by astronomers. In other words, he seeks to prove that the astronomical method of placing a zero year between the B.C. and A.D. years is intrinsically superior to the historical system which places 1 B.C. and 1 A.D. in juxtaposition.

Geometry. "Constructive Geometry" (Blackie and Son), by John G. Kerr, LL.D., is arranged for a first-year's course in science. Its subject matter is virtually the same as that of the first three books of Euclid, but from the construction and examination of drawings the pupil is taught to form ideas about the properties of lines, points, circles, &c., which it is hoped will assist his subsequent comprehension of Euclid's method of dealing with abstract principles.

XUM

MICROSCOPY

Conducted by F. SHILLINGTON SCALES, F.R.M.S.

Collecting Land and Fresh-Water Mollusca.

Some useful hints on collecting land and fresh-water mollusca were given some time ago in the "American Journal of Applied Microscopy" (September, 1902), which has now unfortunately ceased publication; and I think an abstract of some of these hints may prove of service to those who have not seen the larger article. For land shells a "Ferriss" hoe is very useful. This is made by getting a small light-handled garden hoe, and having the blade cut down at a machine shop. It should be about three inches wide on top, and taper to a sharp point; the handle being cut off so that it is as long as a walking-stick. This makes a most convenient tool for turning over logs, breaking up rotten wood, and digging around stumps and among dead leaves. A pair of fine curved-pointed forceps is necessary for picking up small species. Small glass bottles should be carried, as the smaller species are apt to get lost in the dirt and slime if put in the same receptacle as the larger ones. It is better not to put the small species in alcohol as they are collected, as they are then killed at once with the animal more or less extended. If put in a dry bottle and left a few hours they will withdraw into their shells, leaving the aperture clear and fit for examination. This is especially necessary with the *Pupidae*, where the arrangement of the teeth around the aperture is a specific characteristic. For the larger species tin cases of a convenient size for the pocket are most convenient, and specimens from different localities should be kept separate as far as possible. For the fluviatile species a dipper is necessary. This can be made from an ordinary tin one, by removing the bottom and substituting one of fine wire cloth. By removing the end of the handle the dipper can be slipped on to the end of a stick when in use. This is especially useful for sifting the mud and sand from the bottom, where so many small species live, which would otherwise not be found. It will probably be more convenient and thorough to empty the contents of the dipper into a pail, and to carry the whole home before attempting to pick out the shells. The whole mass can then be spread out into the sun to dry and become friable, after which the shells can be easily separated and picked out, an ordinary reading glass being used if necessary.

The land species love dampness and darkness, and are, therefore, to be looked for under logs, bark, and leaves in suitable localities. Many species bury themselves in rotten logs, which must be broken up with the hoe. Accumulations of dead leaves around fallen trees, thick grass and thickets along the margins of ditches and streams will usually repay examination, and should be carefully gone over with fingers and hoe. Coniferous forests are usually quite barren of molluscan life. Nearly every permanent body of water has its molluscs, varying according to its character. Some species are found only in rapid-flowing water, others only in still water and ponds. The low places in woods, which dry up in summer, have a number of species not found elsewhere, and which bury themselves in the mud when it dries. Sand banks in rivers and lakes have many of the smaller species.

The larger *Helices* should not be put into alcohol, as this makes subsequent removal of the animal almost impossible. They should be boiled as soon as possible, nearly hot water being useless. A small wire strainer with a long handle is convenient for holding the snails during this process, and saves difficulty in fishing them out, with consequent risk of over-boiling. The time varies according to the size and species, say from 10 to 60 seconds. If not boiled enough the muscular attachment is not loosened, whilst, if boiled too long, the animal is apt to break in two, and thus give trouble in extracting. Only a few should be boiled at a time, as they "pull" easier while warm. When boiled, the animal must be slowly and carefully pulled out, too much haste causing it to break, leaving the apical whorls in the shell. The curved points of the collecting forceps serve the purpose, and hooks of different sizes can be made from safety pins tied to small wooden handles. A small fine-pointed dental syringe is very useful in starting the animal, or in case it breaks, in which case soaking in alcohol for twenty-four hours usually causes sufficient contraction of the remnant to enable it to be washed out by the syringe. After extracting, the interior of the shell must be well syringed. Any mucous must be removed by small sponges attached to fine copper wire, or when dry it will disfigure the specimen. The outside must be scrubbed with a soft nail or tooth brush, no oil or acid being used on any of the land shells. In the small species the animal can be left. After keeping in a dry place for a short time the animal will retire far into its shell, which must then be put into 25 per cent. alcohol for a day or two, and then dried in the air, after which no offensive odour will be left. Either before or after drying the shells can be cleared by shaking in a bottle with fine clean sand.

In the operculate species, it is desirable to retain the opercula, or part of it. These are easily removed from the animal and, after being cleaned, should be put inside the shell, and the aperture plugged with cotton wool. All foreign matter, both inside and outside the shell, must be carefully removed by thorough washing; deposits of lime or oxide of iron on the water species can be removed with oxalic acid, either by immersion or brushing with a soft brush, but the operation must not be too prolonged or the shell will be injured.

The larger bivalves can be well washed, and, if necessary, scraped off with the knife, as soon as found, care being taken not to injure the epidermis. They can be boiled, when the shells will open and the animals be easily removed, or the muscles which hold the valves together can be cut with a thin-bladed knife and the animal scraped out, care being taken not to break the edge of any fragile species. All traces of animal matter must be removed; and, after thorough washing, the valves can be tied together with string until thoroughly dried, but coloured twine must not be used as it is apt to stain the shells. Any incrustations can be removed with oxalic or muriatic acid, but the specimens must be frequently washed and care used. The smaller bivalves are best put into dilute alcohol for a day or two and then dried. If left too long the shells are apt to open, which looks unsightly.

Both in collecting and cleaning, the specimens from each locality should be kept carefully separated and labelled, as the study of the geographical distribution of the mollusca is most important, and to be of value must be based on accurate work.

Ground Glass for Diagrams for Lantern Slides.

There are several photographic methods of making lantern slides of drawings and diagrams, of which the wet-plate process is perhaps the best; but recently it occurred to me to try a simple method, which has given most satisfactory results, though I do not remember to have seen it suggested elsewhere. All that is necessary is to draw or write with a hard pencil—a 6 H for choice—on ground glass squares $3\frac{1}{4} \times 3\frac{1}{4}$, of as finely ground glass as possible, then to flood the ground side of the glass with dilute Canada balsam in xylol or benzol. Cover with an ordinary lantern-slide covering glass, and bind in the usual way. The only precaution necessary is to avoid imprisoned air-bubbles, and this is not difficult when a dilute solution is used. The glasses must, of course, be first carefully cleaned. The result will be that the ground glass is made transparent, whilst the pencil lines become more distinct.

Royal Microscopical Society.

May 18, 1904. The President, Dr. Dukinfield H. Scott, F.R.S., in the chair. The Secretary called attention to two microscopes that had been presented to the Society. One was made by Ladd about 1864. It had chain movements to the coarse adjustment and to the stage, the motion being particularly smooth and free from back-lash. The fine adjustment was effected by a lever hanging from the milled head of the coarse adjustment, by means of which a very slow motion could be given. The other instrument was a small portable microscope, bearing no date, but similar to one made by Cary. Mr. F. W. Watson Baker exhibited a new objective changer, made by Watson and Sons, also a device designed by Mr. W.

XUM

Rosenhain for mounting specimens of irregular shape, such as sections of metals, so that the polished surface to be examined was normal to the optic axis of the microscope, thus obviating the necessity for a levelling stage. A third exhibit consisted of troughs, invented by Mr. T. G. Kingsford, suitable for fluids for light filters, or for examining aquatic life. They were constructed in various sizes of two flat discs of glass, such as were used for modern clocks, clipped round the edges by a thin metal band, leaving a suitable opening at the top. The band is drawn tight by means of screws near the ends, leakage being prevented by a lining of rubber strips. These tanks can be readily taken to pieces for cleaning, and will withstand sudden changes of temperature. A note by Mr. A. A. C. Eliot Merlin on Mr. Nelson's new formula amplifier was read. The amplifier consists of a negative lens placed in the rear of the objective, and was calculated by Mr. Nelson for the author, to enable him to make some delicate microscopical measurements. With the usual arrangement of a low-power eyepiece and screw micrometer, the magnification afforded by high-power objectives was insufficient to ensure accuracy in all cases, and it was not desirable to use more powerful eyepieces as the spider lines then appeared too coarse. The author found the amplifier yielded especially good results when used for micrometrical purposes, and he suggested its application to students' microscopes for quickly obtaining an increase of magnifying power. Mr. Nelson's formula for the amplifier was given. A note on Grayson's 120,000 Band Plate, by Mr. Nelson, was then read. The band was resolved strongly by an apochromatic oil immersion $\frac{1}{8}$-inch, 1·43 N.A., and a 5 eyepiece. It was also resolved by a semi-apochromatic $\frac{1}{10}$-inch, 1·3 N.A., and 5 eyepiece, and by an old achromatic water immersion $\frac{1}{12}$-inch, 1·2 N.A., but in the last case the lines appeared to have irregularities. The 90,000 band was resolved by an apochromatic $\frac{1}{4}$-inch, ·96 N.A., with some difficulty. The author remarked that the latest books on physical optics state that $\frac{1}{100000}$-inch is the theoretical limit for microscopical vision. Mr. Nelson stated that ruled lines are more difficult to resolve than diatoms of equal fineness. He said the best screen is made from a saturated solution of acetate of copper, many times filtered, to which a very small quantity of methylen blue should be added. Sunlight with a Heliostat was used, and the light made oblique in one azimuth. The theoretical resolving limit for oblique light may *roughly* be taken at 100,000 times the N.A. of the objective. Dr. Hebb remarked that when this plate was exhibited at the Royal Society's Conversazione some of the lines, though resolved, appeared weaker than others. Mr. E. E. Hill said this was due to the objective used having an aperture of only 1·1 N.A. Mr. Conrad Beck exhibited some flower seeds.

Quekett Microscopical Club.

The 414th ordinary meeting of the Club was held on May 20, at 20, Hanover Square, W., the President, Dr. E. J. Spitta, V.P.R.A.S., in the chair. Mr. H. Wallis Kew, F.Z.S., gave an interesting account of the False-Scorpions or Chelifers, illustrating his description with a number of lantern slides. The Chelifers, or lobster mites, as they are popularly called, form a distinctive though little studied Order of the Arachnida. They have been known to science ever since the time of Aristotle, who classed them with the true Scorpions, a mistake which was perpetuated for over 2000 years. Of retiring habits and minute size they may be found in all quarters of the world in suitable places. Shunning the light they conceal themselves under bark, or among mosses and dead leaves, where they lie motionless until their prey wanders within the reach of the terrible pedi-palps or forcep-like claws of the second pair of appendages, which instantly close on the victim, and transfer it to the chelicerae, the smaller forceps near the mouth, by which the victim is held while the juices are sucked out.

Mr. Kew referred at some length to the habit, peculiar to this Order, of attaching themselves by the forceps to the legs of other insects, by which they are transported from one place to another. Sometimes more than one Chelifer is found on the same insect, and there are recorded instances of as many as six, eight, and ten being found so attached. The habit has been known for over a century and has been recorded from every quarter of the world, but its object is still one of the puzzles of science. They do not appear to be parasites, and the fly appears too large to be a victim, so it has been suggested that they are merely stealing a cheap ride at the fly's expense.

Mr. D. J. Scourfield then gave a description of Apstein's Quantitative Plankton Net, which had been devised for the determination of the exact quantity of organic life in a given volume of water. The net had been used successfully on the Scotch lochs, and a specimen net, with photographs showing the method of use, was exhibited to the members.

Daphnia and Vorticella.

Mr. Caffyn, of Hornsey, writes: "I have recently collected a quantity of the Great Water Flea at Dorking, and practically every one of them is covered with Bell Animalcules. I think these are chiefly *Epistylis*, but there are a few *Vorticellæ*. In *Ponds and Rock Pools*, Mr. Henry Scherren says, on page 157, that it has been stated that the common water-flea never bears about with it any of the Bell Animalcules that flourish so luxuriantly on the *Cyclops P.*; this is stated to be due to a slimy film. Mr. Scherren goes on to state that he does not know as to the film being there or not, but he thinks plenty of the *Daphnia* could be found bearing these Vorticellidans, and he says that he has been told by pond-hunters that they have seen them in this state. I do not know if the matter has been definitely proved before; if not, I can certainly verify it now."

Notes and Queries.

W. N. Bone, Hove.

I am glad that Mr. Warburton's articles on Mites have decided you to take up the definite study of the *Acari*. There is so much work to be done here that is well within the powers of anyone who is interested in the subject. Unfortunately, the literature of the *Acari* is in a very unsatisfactory and incomplete state, and I am afraid I can give you no useful references other than those mentioned in the articles referred to. You will find the pages devoted to the subject in "Carpenter" useful as a beginning, however. The articles on Spiders and Mites in the forthcoming volume of the Cambridge Natural History are contributed by Mr. Warburton, and are now in the Press. With regard to killing the very smallest specimens, Mr. Warburton tells me that there is nothing better than boiling water, and that you must try to straighten the legs with a camel-hair brush, under a lens. He says chloroform increases this difficulty.

J. C. Miller, Willesden.

As far as I can gather from your description and drawing, the infusorian referred to must surely be the common *Paramœcium*, or "slipper animalcule." Its length is generally about 200 to 260 μ (μ = ·001 millimetre, and is the standard of microscopical measurement). It is of a very much lower order of life than *Hydra*, and is really unicellular, though the radial striations of the pronounced cortex give it a multicellular-like appearance. There is therefore no definitely marked-off body cavity or *enteron*, though it has a "buccal groove" which leads into a fairly definite mouth, but this communicates direct with the semi-fluid protoplasm within. There is a large nucleus, and a smaller micronucleus, and two contractile vacuoles, which you may have mistaken for eyes. When feeding, the animalcule swallows with a sort of gulp, which carries the particle of food inwards enveloped by a globule of water, which is gradually absorbed later, and any remaining particles subsequently ejected at a soft place in the cortex, which may be looked upon as a potential though not a true or actual anus. It is probably this enveloping globule of water and the curiously sudden method of swallowing that you have mistaken for a "bag." I am sorry to have left your question so long unanswered, but it has been due to circumstances beyond my control, as explained last month.

Micro-Fungi for Distribution.

By the kindness of Mr. C. H. Caffyn, of Hornsey, I am able to offer a limited quantity of specimens of micro-fungi, mostly named, suitable for mounting as opaque objects. Those wishing to avail themselves of this offer should apply without delay, utilising and complying with the terms of the coupon to be found in the advertisement pages of the current issue of this magazine.

[*Communications and enquiries on Microscopical matters are invited, and should be addressed to F. Shillington Scales, "Jersey," St. Barnabas Road, Cambridge.*]

XUM

The Face of the Sky for July.

By W. SHACKLETON, F.R.A.S.

THE SUN.—On the 1st the Sun rises at 3.49, and sets at 8.19; on the 31st he rises at 4.23, and sets at 7.49. The earth is at its greatest distance from the Sun on the 5th, when the diameter of the Sun is a minimum, being 31′ 30″·66.

Sunspots and prominences may usually be observed on clear days, though the change of solar activity to maximum is proceeding somewhat slower than in recent cycles.

The position of the Sun's axis and equator may be derived from the following table:—

Date.	Axis inclined from N. point.	Centre of disc, N of Sun's equator.
July 1 ..	2° 36′ W.	3° 4′
,, 11 ..	1° 56′ E.	4° 7′
,, 21 ..	6° 23′ E.	5° 3′
,, 31 ..	10° 35′ E.	5° 50′

THE MOON:—

Date.	Phases.	H. M.
July 5 ..	☾ Last Quarter	10 54 p.m.
,, 13 ..	● New Moon	5 27 a.m.
,, 19 ..	☽ First Quarter	8 49 p.m.
,, 27 ..	○ Full Moon	9 42 a.m.
July 3 ..	Apogee	5 24 a.m.
,, 15 ..	Perigee	4 12 a.m.
,, 30 ..	Apogee	8 6 p.m.

THE PLANETS.—Mercury is in superior conjunction with the Sun on the 9th, and therefore during the earlier part of the month he is out of range. Towards the end of the month he is an evening star, and sets about 8.45 p.m.

Venus is unobservable, being in superior conjunction with the Sun on the 8th.

Mars rises only about an hour in advance of the Sun, and therefore for all practical purposes is unobservable.

Jupiter rises about 11.20 p.m., near the middle of the month. He is in quadrature with the Sun on the 22nd, and in conjunction with the Moon at 1 a.m. on the 7th. The polar semi-diameter of the planet is 18″·5 on the 16th.

Saturn is coming into a more suitable position for observation in the evenings; he rises about 10.15 p.m. on the 1st, and about 8.15 p.m. on the 31st. Near the middle of the month the planet is on the meridian about 2 a.m.

The apparent diameters of the outer major and minor axis on the 8th are 42″·7 and 10″·3 respectively, whilst the polar diameter of the ball is 17″·0.

The planet will be near the Moon on the evening of the 28th.

Uranus is becoming more favourably situated for observation at convenient times, being on the meridian about 10 p.m. on the 15th. His position on the confines of Sagittarius and Ophiuchus may be seen on reference to the chart in the last issue.

Neptune is out of range for observation.

Meteors.—The most conspicuous shower is the δ Aquarids, which occurs on the 28th; they are slow moving and long. The radiant is situated in R.A. 339°. Dec. S. 11°.

Comet α 1904 is but a poor object, faint and beyond the range of small telescopes.

THE STARS:—

About 9 p.m. near middle of the month:—

ZENITH . Draco, Hercules, Lyra.

SOUTH . Corona, Serpens, Ophiuchus, Libra, Scorpio.

EAST . Delphinus, Aquila, Capricornus; Saggittarius to the S.E.; Pegasus and Cygnus to the N.E.

WEST . Boötes, Great Bear, *Cor Caroli*, Leo, Virgo.

NORTH . Ursa Minor, Cassiopeia. *Capella* on horizon.

TELESCOPIC OBJECTS:—

Double Stars:—ζ Serpentis, XV.^{h} 13^m, N. 2° 13′, mags. 5·1, 10; separation 10″.

β Serpentis, XV.^{h} 41^m, N. 15° 44′, mags. 3·5, 10; separation 31″.

ξ Cephei XXII.^{h} 1^m, N. 64° 8′, mags. 4·7, 7; separation 6″.

δ Cephei XXII.^{h} 26^m, N. 57° 55′, mags. 4·2, 7; separation 40″. A pretty pair for small telescopes, yellow and blue. It is also a variable star; period 5^d 9^h, with a quick rise to maximum in 1^d 9^h.

Clusters.—M5 (Libra). A compact cluster situated about one third of a degree north of the double star ζ Serpentis; when seen through a pair of opera glasses it appears like a large nebulous star.

N.G.C. 6633. Cluster in Serpens. About one-third of the way between θ Serpentis and α Ophiuchi (visible to naked eye).

THE Government Plant Bureau of the United States has just issued suggestive information to the American farmer as to the value of many weeds. Hundreds of tons of dried weeds are annually sent from Europe (not much from England) to the United States, mostly for their drug value. For instance, last year saw ten tons of dried dandelion roots cross the Atlantic. These were worth a trifle over twopence a pound, or a total of some £230, all of which might be considered as wage earned in Europe. In the same period, 250 tons of burdock, used for blood diseases, and worth as much per pound as dandelion, accompanied them. Ten tons of poison hemlock, fifteen tons of tansy, sixty tons of hoarhound, are a few other annual importations of weeds which have earned the malevolent hatred of the American farmer. Thorough as ever, the Plant Bureau gives full directions as to when to gather the various roots, leaves, or flowers; how to dry them, &c. "Whatever may be said of paternal government," remarks the *Agricultural Economist*, "the practical interest which America takes in the welfare of her greatest industry is proving of very real value to her agriculturists."